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I.

THE PRESENT-DAY CONCEPTION OF ACUTE ANTERIOR POLIOMYELITIS.*

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It is a long call from the conception of poliomyelitis anterior, entertained and established by Charcot and Joffroy, to the view of the disease which we are bound to hold at the present day as a result of experiences gathered, particularly in Sweden and in this country, during the recent epidemic occurrences of the disease. I appreciate the opportunity presented by your kind invitation to present in brief the present status of our knowledge, imperfect as it still is in many respects. Orthopedic surgeons have a special title to such information because the first accurate description of the disease is unquestionably due to the account given by one of their number. The description as given by Heine in 1840 has left such a deep impression upon the study of the disease that the latest and perhaps the most thorough writer on the subject, Dr. Wickman, of Stockholm, proposes to commemorate the services of Heine by giving him a part share in the new name which this disease is from now on expected to bear. Wickman proposes to call it, for reasons which we shall be able to appreciate later on, *Heine-Medin's disease*, and the title is to do honor to the work done by Heine in establishing the clinical picture of the disease, while Professor Medin, of Stockholm, has contributed much to the understanding of the variations of this disease, as all of us have been able to observe it in recent epidemics. The

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point that Wickman makes is that the disease is no longer a mere anterior poliomyelitis (inflammation of the cells of the anterior gray matter of the cord), but by its clinical variations and by the extent of the morbid process, it is shown that in some instances the disease may involve the entire gray matter of the cord, the gray matter of the medulla oblongata, and even of the cortex. In some instances the peripheral nerves do not escape. It is for the purpose of including all these atypical forms under one heading, and of grouping together all the varieties of the disease that he proposes to associate the names of these two investigators with the disease instead of speaking of it as anterior poliomyelitis. The wisdom of this is somewhat questionable, for I do not believe that so well established a name as anterior poliomyelitis should be abolished or can be abolished in favor of such a name as Wickman proposes. Nor does it seem to me to be necessary to eliminate the pathological designation, such as poliomyelitis anterior, even though later researches prove the lesion to be a much more extensive one than this name would indicate. It has been shown often enough that tabes dorsalis, posterior spinal sclerosis, and even the clinical designation "locomotor ataxia," do not fully cover all the varieties of this well-known disorder, yet no one, I think, would favor the abolition of any one of these terms and would wish to substitute for them the names of Türck, Romberg or Erb, or any one of the other many writers who helped to establish our full understanding of the disease. I half suspect that it was homage paid by the pupil to his master and considerable national pride which led Wickman to propose this new name. Swedish observers, above all Medin, Rissler and Wickman, have done such astonishingly good work on this disease that if they can succeed in giving a Swedish coloring to it we may well allow them to satisfy their pride. They have surely helped to prove beyond cavil the infectious character of poliomyelitis. Many of us had long since accepted the fact, but the positive proof of it has been afforded by the studies of Caverly in this country, and of the Swedish writers before mentioned, though the earlier writings of Strümpell, in Germany, and of Pierre Marie, in France, who endeavored to show that there was a relationship

between polioencephalitis and poliomyelitis anterior, suggested the possibility that both these forms of disease might be of infectious origin. Let us first see what the facts are that seem to establish the infectious character of poliomyelitis.

The older writers, and I believe I may include myself among them, have insisted upon the seasonal occurrence of infantile spinal paralysis. The statistics gathered at all the larger clinics prove that poliomyelitis occurs most frequently during the months of July and August, and I see that in the last analysis by Dr. Joseph Collins of five hundred cases occurring during the recent New York epidemic, the largest number of the cases have occurred in July, August and September. In October there was a marked subsidence of the disease. But in past years we have had only sporadic cases to deal with, whereas the epidemics in Sweden in 1906 and the New York epidemic of 1907 have shown not only this peculiar seasonal occurrence, but have also shown that the epidemic raged during the summer months and promptly subsided in the early autumn. The subsidence is so sudden as to be truly remarkable. I was pleased to find that your president wrote on the epidemic occurrence of the disease in New York, so long ago as 1897.

The New York Poliomyelitis Committee, of which I have the honor to be chairman, is struggling with the study of the manner in which the disease spreads from person to person. In a large city such studies are peculiarly difficult, and it will not do for me here to forestall the conclusions which this committee may reach and which are to be published during the coming year. In the meantime, however, we have the excellent studies of Wickman, who was particularly fortunate in being able to trace the spread of the disease from one small hamlet in Sweden to another, and able to show that the disease must necessarily be a contagious one. Studying the spread of the epidemic in a small place called Traestena, he was able to establish the fact that the disease often attacked several members of the same family and was carried to other houses and to distant places by persons who had been in contact with those persons suffering from the epidemic disease. He was able to show that the village school was the fertile source

of contagion and that the contagion was carried by intermediate persons (a rule that holds good with other epidemic diseases) who remained exempt. This contention has been established in the most painstaking way and anyone who will take the trouble to read Wickman's monograph will feel convinced that his contention cannot be controverted, and yet it is worth bearing in mind that the disease has been endemic practically in every large city. Patients have never been isolated, and still in all these years until the epidemic occurrence of the disease, no writer has been able to report cases occurring in the same household or in the same family, except that one writer years ago claimed that a case of infantile cerebral paralysis had occurred in a family after an attack of infantile spinal paralysis in another child. Even during the past epidemic in New York no attempt at isolation was made either in hospitals or in private families, and while a few instances of the multiple occurrence of the disease in one house or in one family have been reported, it is worth while noting that the epidemic has not spread in any larger institution, so that we should be compelled to class the disease at least among the mildly contagious ones. Nor has the character of the infectious agent been successfully established. About ten years ago, Schultze, of Bonn, performed lumbar puncture in cases of acute anterior poliomyelitis and claimed that he found in the cerebrospinal fluid meningococci of the Jaeger-Weichselbaum order which he thought were of etiological significance in infantile spinal paralysis. Two Norwegian writers, Lofft and Dethloff, found microorganisms in the cerebrospinal fluid which resembled the meningococci, and a third Norwegian, Geirsvold, examined the cerebrospinal fluid during the 1905 epidemic and claims to have found special microorganisms. Wickman, who refers to these investigations and to the tetracoccus found by Geirsvold, is not able to indorse the latter's findings. Wickman's investigations did not yield any satisfactory results and he believes that the question has not as yet been solved. In spite of the organisms found by these authors and by Ellerman, a German writer, we may claim that the true bacterial agent, or at least the infectious microorganism, whatever its character may be, has not yet

been revealed. The search for this microorganism must continue and I have little doubt that before long such studies will lead to entirely satisfactory results.

Even the symptomatology of poliomyelitis has undergone considerable modification, and this is due very largely to the fact that the clinical picture of poliomyelitis was based almost entirely upon the late conditions of the disease. The study of the earlier stages has naturally been neglected, as the vast majority of the cases was seen in dispensaries and out-door departments, and the earlier stages had either been overlooked or poorly described in accordance with statements made by relatives of the patients afflicted. We all knew that the disease was supposed to begin with fever, with or without convulsions, with general malaise; within 24 or 48 hours a flaccid paralysis of one or more of the extremities was established; the paralysis was fully developed within a very short period of time—say within a day; the paralysis would be stationary for a time, then more or less recovery would set in, leaving some one part or some group of muscles completely paralyzed. The paralysis was marked by all the symptoms attendant upon the affection of the peripheral or motor neuron; *i.e.*, paralysis, atrophy, loss of reflexes, marked electrical changes, vasomotor and some trophic changes with the entire absence of sensory disturbances. When the acute stage of the disease had passed, the paralysis was more or less firmly established in one or more groups of muscles and the prospect of complete recovery was a very gloomy one. What happened in the very first days of the disease or in the prodromal period was not known, though often guessed at. The study of the recent epidemic has brought out most convincingly the facts that the disease begins very much as all other acute infectious diseases do—with general malaise, with fever, with convulsions, with headaches, and these may last for a number of days before the symptoms of paralysis are developed; but the one fact which we did not appreciate until our own recent epidemic had occurred was that these prodromal and early symptoms may occur without any permanent paralysis ensuing. We have seen in New York, and similar cases have been reported by Wickman and Medin,

undoubted cases of infection in which the paralysis either did not set in at all or was of such transitory character that every vestige of paralysis disappeared before the child was rid of its initial infectious symptoms. We must therefore allow that there are abortive forms of poliomyelitis. While these cases were extremely favorable in every way, we have been particularly struck by a group of almost furibund cases in which all the early prodromal symptoms were fully developed. The child exhibited high fever, complete paralysis of all four extremities with involvement of parts supplied by the lower cranial nerves, and death ensued within 48 or 72 hours of the onset of the symptoms. In several such cases which were under observation at Mount Sinai Hospital, autopsies were performed by Dr. Strauss, and his investigations will constitute a very important part of the work of the New York Committee.

In these rapidly fatal cases the paralysis assumed the appearance of ascending Landry's paralysis, so that the question has again come to the foreground as to whether or not Landry's paralysis may not be a severe toxic or septic form of poliomyelitis. In the majority of these rapidly fatal cases, bulbar symptoms pointing to the involvement of the nuclei in the medulla oblongata were observed, and this special spread of the disease has no doubt had an important bearing upon its fatality. In still other cases there was an acute ataxic disorder following upon the symptoms of initial infection in which it is fair to say that either the cerebellum, or tracts connecting with the cerebellum, must have become involved. Strümpell and Marie suggested years ago that infantile cerebral paralysis was the counterpart of infantile spinal paralysis, and that in one group a polioencephalitis gave rise to the symptoms, while in the other poliomyelitis was the direct cause. Of this view there seemed to me to be very little proof, and years ago I was one of those who strongly combated this theory. Although the anatomical proof has not been forthcoming to any satisfactory degree, the occurrence of cerebrospastic paralyses in families in which some infantile spinal paralysis had occurred lends support to this doctrine. I am willing now to modify my former contentions

to the extent of believing that some of the cases of cerebrospastic paralysis may be due to an infectious polioencephalitis, but I am not yet willing to grant that the majority of the cases of cerebrospastic paralysis in children can be explained in this way. However, this point does not bear directly upon the question under discussion, but it is far more interesting to know that to a certain extent we often have to modify views which we have endeavored to establish by persistent research.

For years and years in neurological literature, the struggle continued to establish a marked difference between poliomyelitis and multiple neuritis. In the early eighties, volumes were written on this subject, and the writers were proud of their success in being able to differentiate between the two diseases and to show that they were entirely distinct from one another. About ten years ago Gowers reported a case of poliomyelitis with peripheral neuritis. It was recognized by all those who had seen patients during the recent New York epidemic that cases occurred in which it could not be stated with certainty whether the person was suffering from one disease or the other, and this same difficulty is now so freely acknowledged in the monograph of Wickman that he speaks of a polyneuritic form of the Heine-Medin disease. I have had under my own observation at the hospital a burly young fellow who had been a steel worker, and who, during the month of August, 1907, was seized with a paralysis of all four extremities with involvement of the neck muscles and of the abdominal, so that for months he lay absolutely paralyzed. The disease began at the very time when the poliomyelitis epidemic was at its worst. The extreme painfulness of the larger nerve-trunks, the hyperesthesias in various parts of the body, and the moderate though well-pronounced atrophies corresponded much more to the clinical picture of a multiple neuritis than of a poliomyelitis. In the manner of recovery, too, there was much more resemblance to the peripheral than to the spinal disease, for when recovery once began to be established the progress was relatively rapid and there was no such residue of paralysis left as we commonly see in typical poliomyelitis. For many an hour I have stood over this patient pondering over the diagnosis as to

whether I should make it multiple neuritis or poliomyelitis. I finally came to the conclusion that it mattered little whether I called it one or the other, the fact was that the disease was unquestionably due to the epidemic raging at the time in New York City, and that, after all, it was not a matter of grave significance whether the infectious agent exerted its full force in the cells of the gray matter of the cord or whether it involved the peripheral nerve and the peripheral motor neuron, beginning in the spinal cord and ending in the muscle. The surprising fact is that the infectious agent which attacks one part does not more frequently attack the peripheral division of this same neuron. Possibly the fact that the blood supply is such that the infectious agent attacks the spinal part of the neuron first may be largely responsible for the relative immunity which the peripheral nerves enjoy.

I had the satisfaction of seeing together with Dr. Gibney another excellent example of poliomyelitis in a girl of about sixteen years, and this girl showed, long before the acute symptoms disappeared, such marked sensitiveness of the posterior tibial distribution that there can be no doubt of an association in this case of a poliomyelitis with a peripheral neuritis. We have so long stood under the ban of the purely anatomical division of nervous diseases into cerebral, spinal and peripheral, that we have to strain our own minds and adapt them to the facts as presented by more recent studies. I have no doubt that the elaborate structure which we have erected on anatomical lines will some day crumble to pieces and in its stead we shall have a more compact edifice erected on etiological lines. At all events, we may be certain that infection takes very little regard for purely anatomical structures; it seems to strike here and there and everywhere.

And just one more reflection is suggested in connection with this same subject: Many of the cases that have been studied in these various epidemics have shown symptoms of a meningeal order, so that in not a few instances the initial diagnosis was in doubt for a few days as to whether the case was one of cerebrospinal meningitis or of poliomyelitis. In a very large number of

cases, and in several of those which I myself have had occasion to see, there was not only considerable mental stupor, some slight thickness of speech, but also marked rigidity of the neck and, in a few instances, opisthotonos.— The further course of the disease with its typical palsies, its loss of reflexes and its electrical changes put the diagnosis beyond doubt. The inference, therefore, is— and this is a point which was not sufficiently suspected in former years—that there must be some meningeal involvement in a fair proportion of the cases, particularly in the severer forms of anterior poliomyelitis. Inasmuch as the disease itself may involve a lesser or greater part of the entire spinal cord, it requires but a little stretch of the imagination to suppose that the infection was not only limited to the ventral portion of the cord, but also extended to the adjacent meninges, and in this way we shall be able to explain not only the early rigidities, but also the marked spinal pain which has been noted in some of the cases. Such an extension is, however, so easily understood that for that reason alone no one need propose to change the term *poliomyelitis* and to substitute for it the term *acute meningopoliomyelitis*.

This brings me back once more to the name proposed for the disease. After all is said, the fact remains that the infection exerts its greatest force in the gray matter of the cord, that in the earlier stages of the disease the entire gray matter of the spinal cord and, in some rare instances, of the medulla oblongata and of the cortex may become involved, but after a while the trouble subsides and the residue of the disease is apt to lead to pronounced changes in the anterior gray horn. Just as in locomotor ataxia, even if we find occasional changes in the ganglia, in the peripheral nerves and in the cortical structures no one would doubt that in 99 per cent. of the cases the symptoms of locomotor ataxia were due to changes in the posterior columns. If we do not wish to be prejudiced by the term poliomyelitis, it seems to me that the term acute infantile spinal paralysis, or epidemic infantile spinal paralysis, will meet every possible objection. Instances of cerebral or peripheral involvement are on the whole so rare as to be almost negligible.

Our enlarged knowledge of epidemic poliomyelitis has also

modified our views regarding the prognosis. First of all, as I insisted many years ago, the general profession have always taken too grave a view of this disease. Beginning with the worst forms, those in which there is bound to be some residue of paralysis, it is well to remember that there is no telling at the beginning of the disease how great or how small this residue will be. I have often seen paralysis that was very severe at the onset dwindle down to a residue amounting to the paralysis of only one or at most a few muscles in the leg or thigh, deficient action of which could easily be compensated by some artificial measures. At the present day it is also well to remember that there need be no lasting paralysis whatever. On the other hand, those who see the cases earliest, and particularly during an epidemic, must remember that there are now and then fatal cases, but the cases that prove fatal show great malignancy within the very first day or two after the onset of the disease. That some cases recover fully I can state positively after recent experiences—a statement which I should have been loath to make some years ago. If we bear in mind that the disease may result in very limited paralysis, that the paralysis may disappear altogether, we surely have no reason to shake our heads at once and, whether we look wisely or not, to insist that the child so afflicted will be more or less of a cripple for the balance of his or her life—a statement which I have often heard. There are few diseases for which so much is to be done and should be done as for acute poliomyelitis; and here I am happy to be able to address myself directly to those who are most concerned in this treatment.

Except as a matter of exercise, electricity is practically useless. Drugs have no effect upon the subacute or chronic stage and surely not after the permanent paralysis has been established. Massage will no doubt improve the circulation of an affected limb and should be encouraged so far as possible. Methodical exercises I consider of the utmost importance, but these should be conducted under the supervision of a competent person, of one who knows what can and what cannot be expected of a paralyzed limb or of a paralyzed group of muscles, and of some one who is able to note the slightest return of power in a muscle or group of

muscles, is able to avail himself of that slight improvement and, when the improvement is once noticed, intelligently to encourage such movements so as to get satisfactory results. But valuable time is still wasted in the main hope that Nature will help itself or that deformities will in some way right themselves. I am perfectly willing to attach some of the blame for this to the neurologist—let me say the old-time neurologists, who had pinned their faith to massage and electricity and who would not dream of interfering with the badly paralyzed limb. Some blame is also to be attached to the orthopedic surgeons who do not seem to have sufficient faith in the surgical measures at their command. I need not tell you what to do; all I need to suggest is that after the disease has run its acute course and the chronic stage has been established, take stock, as it were, of the active and inactive muscles of the limb, of the flaccid and of the contracted groups, and wherever the innervation can be converted from an over-acting to an inacting group, do not hesitate to do so. I am a thorough believer in tenotomies and in transplantation of tendons, and nothing that I have seen of orthopedic work has impressed me more than the operations undertaken by the lamented Hoffa for the shortening or lengthening of tendons and muscles. These are purely mechanical problems and for one I would urge the freest possible exercise of such measures as are at your command, and would, above all things, caution you against expecting spontaneous improvement after a flaccid, atrophic paralysis has been firmly established. The present conception of poliomyelitis has not only thrown new light upon the theory of the disease and upon its pathogenesis, but has also put the duties of the orthopedic surgeon in an entirely different light. We look to him for the correction of deformities after the acute infectious disorder has run its course and has done its worst.

II.

THE ULTIMATE RESULTS IN THE SURGICAL TREATMENT OF INFANTILE PARALYSIS.*

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It has been said that the world advances through impossibilities achieved, and the present results of the treatment of infantile paralysis may serve as an illustration of this saying. More than a generation ago paralysis in childhood was considered a hopeless and little understood affection. The introduction of subcutaneous tenotomy aided in the correction of the deformity and was the surgical wonder of the time. After the recognition and study of the nature of infantile paralysis, little help followed and the evidence of benefit from treatment by massage and electricity was so slight that for relief patients were taken to empirics or to the instrument maker. Some progress was made in the skillful devising of proper apparatus, and the improvement in locomotion in certain cases from properly made appliances was marked. Treatment twenty years ago consisted in the correction of the deformity and in furnishing appliances which enabled the patient, aided by appliances, to walk by the use of such muscles as had escaped the original paralysis. The neurologist has helped but little, except in a recognition of the pathology of the disease. From those days of surgical despair to the present condition where practical help can be given to a large number of cases the progress has been steady and in some instances in directions which at first promised but little. No one would have expected that as an outcome of the work of Gluck, shown to the world at the Interna-

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tional Medical Congress at Berlin, there would come the present method of silk-strand transplantation, nor would it have been thought from the numerous failures which followed the first attempts of tendon transplantation that an efficient method could be devised which would be of use in a large percentage of cases.

From a study of the literature of the subject it is clear that there is danger of exaggerating the benefit to be obtained from newly introduced methods, and for this reason it is desirable in a critical review of methods of treatment to generalize from cases where the treatment has been completed and the results obtained some time before the final estimate of the value of the methods introduced. The conclusions which are here presented are drawn from cases observed, many of them after observations for a number of years, and after an experience of nearly twenty years in the employments of the various methods of treatment which were from time to time presented to the medical profession. Besides cases under personal care, the experience which is the basis of this paper includes a large number treated at the Children's Hospital largely under my own direction in the service of myself and my assistants and my colleagues. These cases number now five hundred, and have in all instances been carefully studied and the terminal results noted where it was possible. In addition to these, a considerable number of cases in the last three years have received especial personal attention. Out of consideration for brevity in this paper, attention will be directed more particularly to paralytic deformities of the lower extremity and the results following the employment of silk-strand elongation in tendon transference and the use of silk ligament in the fixation of loose joints following infantile paralysis.

In many cases it has been found that by the proper application of suitable appliances the patients may be given activity and usefullness. A certain amount of increased muscular power is developed by the use of the limb which does not follow from massage or electricity; those muscles which were atrophied from disuse become strengthened by use; deformities, which follow the adapted contraction from the positions necessitated by the bedridden or chair confinement necessitated by paralysis, are pre-

vented by apparatus and by activity. Some muscles which show but little apparent reaction where the paralysis has affected a portion of the muscular fibres, if not the whole, may gain in function by such use as is given them by apparatus which protects them from being overstrained by the greater power of the opposing muscles.

In addition to these the following methods of operative interference in the treatment of infantile paralytic deformities are at present employed: First, tendon transplantation—properly speaking, that is the transplantation of a strong tendon into a weak tendon; second, transplantation with periosteal insertion, the transferred tendon being connected with the periosteum at the point of insertion of the paralyzed tendon, artificial silk strands being used if necessary to elongate the tendon; and, third, arthrodesis, or stiffening of the paralyzed joint by means of refreshing the ends of the bones forming the joint and removing the cartilaginous covering. The method of nerve transplantation has been employed in a certain number of cases, but at present it must be regarded for paralyses of the lower extremity as of uncertain value. Although these methods, as mentioned, are not incompatible, there is much diversity of opinion among surgeons as to their respective relative usefulness. They have both their advantages and their disadvantages which can well be considered.

First.—Tendon transplantation.

The advantage of this method is the relative simplicity of the procedure, involving, as it does, no risk, slight destruction of tissue, and in certain instances marked immediate benefit, which sometimes may be permanent. The disadvantages are, however, that the ultimate results are not in all cases as good as is to be desired, and relapses of the deformity may occur.

Periosteal Insertion.—The disadvantage of this method is that in many instances a foreign substance—*i.e.*, a silks strand—is introduced into the tissues which may irritate and slough out. The operation may not be as simple as tendon transplantation proper, and the procedure requires the exercise of skill and experience. The advantages of the method, however, are marked. It has been proved without doubt that a firmer hold can be made at the

point of insertion by the artificial silk tendons stitched into the periosteum and bone than by the insertion of tendon into tendon. Furthermore, the surgeon utilizing lengthened tendons has a greater choice in the selection of the muscles to be transferred and can also insert his artificial tendon at such points as may be mechanically desirable. The field of usefulness of the operation is therefore much greater than that where the surgeon is limited simply to tendon-to-tendon insertion. The fact that somewhat greater care is required is claimed to be counterbalanced by the fact that better results are obtained in a greater number of cases.

Arthrodesis.—The objections to arthrodesis are that it necessitates a mutilation and loss of function, and in young children, where the ends of the bones to be united are largely cartilaginous, arthrodesis involves a considerable destruction of tissue without preventing, through the later growth of the limb, a recurrence of the deformity. Arthrodesis, however, finds its place in cases of flail-joint where all muscles are paralyzed, and, when successful, enables the patient to dispense with apparatus. For an appreciation of the relative value and success of these different methods, acquaintance with the excellent results which have been obtained by many surgeons is of importance. It should be borne in mind, however, that statistics and the statistical method are not always a definite guide as to the value of the operation performed, and the ultimate results several years after the operation furnish the true test. There is no question, however, that even when this test is applied permanent cures are effected by all these methods, and Hoffa was undoubtedly right in claiming that the surgeon should be able to make use of any of these methods, the choice being dependent, to a certain extent, on the locality and amount of strain coming upon the limb and the extent of the paralysis. Many of the failures in tendon-to-tendon transference which are attributed to stretching of the transferred tendon are in reality due to faulty methods in transferring the muscles. Shortening of the paralyzed tendon alone, although temporarily correcting the deformity, does not, in the majority of instances, prevent subsequent stretching of the affected tendon. In this respect there is a great

advantage in the employment of silk strands which, if properly inserted, are certain not to stretch. The experience of Lange as well as that of other surgeons has shown definitely that the silk strands become the centre of an organization of fibrous tissue which furnishes a permanent and strong artificial tendon.

It has also been shown that under proper precautions in the majority of instances there is no danger of the sloughing out of the tendons. It is also true that even under the best of care this accident sometimes occurs, but, where it occurs, it does not necessarily prevent as a result a useful foot.

That arthrodesis should not be performed in young children is evident. It is a question also whether the operation should be frequently performed at the knee. In most cases the patient can be furnished with a proper splint which will allow both the bending of the knee and active locomotion with not so great an inconvenience as that suffered by a patient with an artificial limb. The case is different in paralytic affections of the foot, where play at the ankle, although convenient, is not a necessity. The operation of arthrodesis, therefore, will find its chief field of usefulness at the ankle-joint and midtarsal articulation. It is probable that the method of arthrodesis introduced by Whitman for calcaneus deformity, namely, removal of an astragalus and placing the os calcis backward, furnishes the best method of treatment for that deformity, tendon transference not having proved hitherto a great success in a large number of cases in the calcanean form of paralytic deformity. The experiences of Hoffa, Vulpius, Lange, Jones and Tubby, Kirmisson, Redard, Whitman, Townsend, Gibney, Goldthwait and many others are sufficient to substantiate the value of the surgical interference in the correction of paralytic deformities.

In this connection the experience gained at the Boston Children's Hospital is of interest. The number of cases treated by the application of apparatus for the correction of deformity, with or without operation, has been large in the last thirty years. Tendon transference has been performed in 120 cases in the last eleven years; arthrodesis has been performed in 50 cases. The writers have collected the record of 62 cases operated upon

between 1895 and 1905 (*Cleveland Med. Journal*, June, 1906) and information was received in 48 of these as to the terminal results. In 33 improvement was noted. In 35 cases reported by the writers (*Boston Med. and Surg. Jour.*, Nov. 1907), treated (at the Children's Hospital or elsewhere in adult cases) by periosteal transplantation, 26 being deformities of the feet, 7 of the feet and knee, 3 of the shoulder, all gave evidence of satisfactory improvement from the operation. In addition to these the writers are able to report 20 cases, operated on since 1907, of deformities of the foot and lower extremity, the operation being a periosteal tendon transplantation in children and adults with, in some instances, the aid of artificial silk ligament fixation. The writers have been able to obtain the ultimate results in several of these cases three and four years after operation, and from these certain generalizations are justified.

It was claimed by Lange, at the recent French Congress of Surgeons, 1907, that by the method adopted by him—that is, by the tendon transplantation with periosteal insertion and artificial silk ligaments—it is possible to prevent a relapse of the deformity and in a certain number of cases to obtain complete restoration of function.

It would appear demonstrated that in deformities of the feet, at least, there is a distinct advantage in the periosteal insertion with artificial silk tendons over tendon transplantation. This was seen in two cases recorded by the writers, where an operation of tendon-to-tendon transference in foot deformity was performed with but little benefit, and much greater benefit was obtained by a second operation with periosteal insertion of artificial silk tendons. The notes of these cases are given below.

The experience of the writers confirms the opinion of other surgeons that the operation for arthrodesis is not one which should be performed on children younger than 10. The experience at the Children's Hospital has also shown that the operation of shortening the paralyzed tendons after correction of the deformity, by taking a reef in the tendon, is not one which gives permanent benefit. In several instances, although the operation was performed with skill and with temporary benefit, subsequent use of

the limb stretched the tendons so that a relapse of the deformity took place.

The statement made by Jones (*British Med. and Surg. Jour.*, March 28, 1908) was supported by the experience at the Children's Hospital that indications for tendon transplantation are:

1. To fortify the weakened group of muscles.

2. To supplant a completely paralyzed muscle or group of muscles.

3. To obstruct the overactive spastic movement of the muscles, and that in arthrodesis the operation should not be performed on children under 8; that it should not be performed until the surgeon is certain that the muscles are paralyzed beyond hope; that the foot deformity must be corrected by wrench or tenotome; that the operation should be so planned that at its completion the bones lie in apposition to the foot, which should be placed in an overcorrected position. Splints should be applied and retained until union is complete and the appliance should be worn until the surgeon is certain that the patient can bear the body weight without fear of yielding. It is also true, as is mentioned by Mr. Jones, that the deformity should be overcorrected as a preliminary act; that the deflection of the tendons should be direct and not on a slant; that there should be a free tunnel through the soft tissues in one plane; that there should be firm suturing in the periosteum or bone; that there should be careful choice and nursing of the transplanted tendon, and that there should be maintenance of the hypercorrected position until voluntary power is assured to the tendon and that the body weight during walking should be deflected from the reinforcing tendon. It may be well, in addition, to shorten all paralyzed tendons and lessen the action of their opponents by the operation of tenotomy. Scrupulous asepsis is essential.

In addition to these methods for surgical relief of this deformity, the surgeon has recourse to fixation by artificial silk ligaments, which is of especial advantage in children and as an aid to tendon transference, protecting the transferred muscles from undue strain during the period when their condition needs to be nursed.

It is manifest that certain portions of the muscles in a paralyzed limb become weakened and atrophied by disease, being overpowered by the stronger opposing muscles, but where the opposing muscles have been temporarily weakened and the deformity corrected, these weakened but not paralyzed muscles may become strong, regaining function to a greater or less extent, if protected from strain. As it has been shown that silk strands properly introduced become organized and surrounded by firm fibrous tissue, it is clear that if the relapse of a deformity is prevented by artificial ligaments, the muscles heretofore enfeebled by the deformity may, if protected from strain, regain some of their power. This was amply illustrated by a case operated upon by the writers with the introduction of silk strand ligaments four years ago, where restoration of function and ability to raise the front of the foot has been gained after a severe paralysis with foot-drop without tendon transference.

It is evident that no greater difficulty need be encountered in placing artificial silk ligaments than in employing artificial silk tendons except that special care is needed in securing firm attachment to the periosteum both at the point of origin and at the point of insertion. It is also evident that considerable attention should be paid to technical details in order to secure the best results, and in this the experience of every surgeon who has met with success in the operative treatment of these cases is of value, as at present there is still some diversity of opinion as to the relative importance of certain details, some surgeons preferring small incisions, while others make use of free dissections, surgeons differing in their preparation of silk strands and their attention to the details of after-treatment.

The writers feel convinced that certain methods are of importance and would like to call attention to them in performing these operations. An an illustration, the operation needed for the correction of a common deformity from infantile paralysis, front foot-drop with a paralysis or loss of function in all the anterior muscles, the tendo Achillis alone being saved, is as follows: For simplicity the case will be assumed to be that in a young child where little or no deformity has as yet developed with

the exception of that of the tendo Achillis. The object of the surgeon is to give the patient as useful a foot as is practicable without the expectation of complete restoration of function owing to the extensive paralysis. The first step in the operation would be the thorough cleansing of the skin and absolute asepsis. Various methods have been tried by the writers: painting the skin with iodin; the use of alcohol; the employment of rubber tissue protecting all parts of the skin except that incised. At present, however, the writers employ, in addition to the ordinary preparation of the skin, the thorough washing with Harrington's solution, a combination of alcohol, hydrochloric acid and corrosive sublimate. The operation should be performed with gloves and masks, with every possible attention to aseptic detail.

Silk strands.

The writers at first simply boiled the silk strands No. 14 or 16, but more recently they have been inclined to follow the advice of Lange and subject the silk strands to a double boiling, the second being immediately preliminary to the operation, the strands being boiled in corrosive 1–1000. The writers prefer short rather than long skin incisions. The surgeon naturally finds it much more convenient to employ a long incision, as it enables him to more quickly select the tendon to be freed, but as one of the desiderata is to obtain a healing by first intention, this is more readily obtained in short incisions where the healing process is more protected from strains than where one long incision is employed.

In the deformity under consideration the incision is made over the posterior border of the tibia slightly above the inner malleolus and, with a blunt dissector and hook, the upper portion of the tendon of the flexors of the toes is isolated and exposed, the deep fascia being divided for this purpose. As soon as these are found they are pulled out of the wound as far as possible, and, if necessary, the lower end of the incision is lengthened to a slight degree toward the sole of the foot. As it is impossible to remove the whole of the flexor tendons, these are cut off as low as is practicable, held by forceps, and the lower portion of the peripheral ends of the cut tendon secured by quilting in the tendon a silk strand No. 14 or No. 16 in size. The suture is passed along one

side of the tendon and then across the tendon and back on the other side so as to give a firm hold upon the tendon, care being taken that the silk strands are of even length. In broad tendons the silk strands should be double, making four strands to each tendon, but in the smaller tendons two strands alone should be attached to the cut end of the tendon.

It is desirable that the tendon and muscles should be protected as far as possible from unnecessary manipulation. It is also especially important that the muscles should not be exposed to irritating dryness, and for this reason the suggestion of Dr. Binney, of Kansas City, is of value, namely, that the muscles and tendons should be coated with sterilized vaselin or sterilized albolin to prevent drying during the period of exposure. Lange's advice that the freed muscles should contain as much fatty tissue as possible is important, but it must be remembered that the amount of fatty tissue surrounding the muscles of the leg and the tendons of the feet is small, especially in children, but this may be remedied by the thick coating of sterilized vaselin which will afford protection from drying or irritation.

The process of tunneling the tissues for the passage of the tendon can be readily done by the use of long curved-handled forceps which can be ground down in such a way as to be as flat as possible. The writers have used such forceps as are used for holding gauze in wiping out the bottom of wounds, made as flat as possible by grinding. The ends of the silk strands are seized by these forceps, which are then passed forward from the incision behind the tibia underneath the subcutaneous tissue and muscles, the point being kept as close to the bone as possible. When the end of the forceps holding the silk strands is felt projecting in the front part of the middle of the leg, a short distance above the annular ligament, a small incision is made in the skin and the ends of the silk strands seized by small forceps, after being released from the longer forceps, passed in behind; the long forceps are then removed and the silk strands brought forward, the tendon being pulled so that the transferred belly of the muscle is as tense as possible. The surgeon can then close the incised wound behind the tibia, it being important that the fascia should be

sewn over the transferred muscle by deep sutures, catgut being used. The silk strands projecting from the wound and connected with the transferred tendon are then ready for insertion at such points as may be desired. Where both flexors are transferred, the surgeon will have four strands projecting from the wound. These can be utilized in such a way as may be desired. Where the paralysis is as extensive as in the case mentioned, the surgeon will probably be content to prevent front foot drop and will aim to insert the silk strands at four points on the outer and inner side of the dorsum of the foot. This can be done by tunneling the tissue hugging the bone by means of the forceps already described, which should be passed from the small incision in the median line on the front of the leg down the other side of the foot. The forceps should be armed with the silk strands and the incision should then be made in the skin at a desired point, the silk strands being pulled out and the forceps turned. It is sometimes advisable to make an incision in the lower portion of the foot and pass the forceps from below up. This, however, depends upon the convenience of the surgeon and the size of the foot. After the silk has been passed through the lower incision, it is ready for a periosteal insertion. The writers have found a ready way of making this by employing a specially constructed sharply curved-handled needle and placing this in the incision on the dorsum of the foot and passing it with force through the tendon, the periosteum and, if necessary, the cartilage. One of the silk strands is then passed through the eye of this handled needle, and when the needle is withdrawn the silk strand will be left attached to firm tissue. It is sometimes necessary to again quilt the silk strands to another portion of the periosteum, but this will depend upon the condition of the tissue. In some instances the writers have tunneled through bone, but in later cases this has not been found necessary.

After all the sutures have been secured, the deformity having previously been corrected and tenotomy of the affected muscles done, the silk strands should be tied firmly, care being taken that no projecting knot should remain. In the deformity described it will usually be found advisable to reinforce the correction by

means of artificial silk ligaments. Where this is done, the operation described remains the same; but in addition to this, the incision on the front of the leg should be longer so as to enable the surgeon to find, by means of a handled needle, a proper attachment to the periosteum of the tibia and adjacent fibrous tissue for silk ligaments. The silk ligaments are then passed down and inserted to the outer and inner side of the dorsum of the foot in the same way that the artificial tendons are inserted.

It is evident that where there is a tendency to varus or valgus the silk ligaments can be reinforced on either side.

In the operative treatment of this deformity some surgeons have recommended, and the authors have employed, the transference of a split portion of the tendon Achillis, which is brought forward and furnished with silk strands as may be desired in the front of the foot. Experience of the writers in the use of this method leads them to the opinion that the split portion of the tendon Achillis, so used, acts only as a retaining check with the disadvantage that the tendon Achillis may be weakened by the process. There appears to be, therefore, no great advantage over silk ligaments except in large feet.

It is manifest that with the different deformities the method used must vary considerably. The writers, in calcaneous deformity, have made use of several different procedures from osteotomy of the end of the os calsis with transference of the peronei to the insertion of a silk-strand insertion on its upper portion to the ham-string muscles and, more recently, the employment of Whitman's operation. In one instance of this deformity nerve grafting was used, but the terminal result is not known.

Much care is needed in the application of the dressing, as it is especially important that first intention should be secured, and as little disturbance of the fresh wound as possible be made. It is desirable, first, that careful closure of the wound, including the fascia, over the tendon and the skin by means of catgut sutures be carefully made. The wound should not be sewn too tightly and the writers employ catgut drainage. The wound is then to be covered with a layer of sterilized vaselin and over this some form

of protection applied. The writers in many instances used a thin, firm layer of transparent celluloid or gelatin, such as furnishes the backing of kodak films, which after soaking in warm water can be freed from the negative layer and a thin, transparent material left which can be cut to the desired shape and placed over the wound. The dressing is laid over this and by means of the film the tissues and granulations are protected from any irritation, even when the surgeon desires to remove the dressing and inspect the wound. The foot should then be covered with proper dressing and is then secured in the corrected position by means of a plaster bandage with a window cut through the plaster enabling the wound to be inspected at the end of two days, and in case there is swelling from retained serum this can be relieved by pressure. After this fresh dressing can be applied and, as a rule, the wound is not seen until it is healed, at the end of two or three weeks. Great care must be taken in the application of the plaster bandage that the wound on the front of the ankle or dorsum of the foot is not subjected to constant pressure. The dressing over this should be loose and a window should be cut in the plaster of Paris; it is covered by either a plaster shield loosely applied or by bandages in which cotton wadding is applied to that portion of the limb. It is to be remembered that a plaster bandage, as it furnishes compression, may cause adhesions of the paralyzed muscles. As little pressure as is possible should be applied by the plaster bandage which necessarily causes muscular atrophy and the bandage should be removed as soon as practicable, usually after three weeks or a month. Great attention should be paid to the subsequent retention of the limb by a proper apparatus. The patient, using crutches to protect the transferred muscle from strain, also needs a carefully selected apparatus which when worn prevents any strain upon the transferred muscle, tendon or ligament. This should be worn for four months until the prospect of the ultimate result is clear. Much attention should be paid to shoes. Heavy, stiff boots, tightly lacing the ankles, are to be avoided. Either low, loose shoes or moccasins should be worn as soon as possible and ordinarily three months following the operation the foot should be free for a time each day and the patient allowed to

stand or walk without appliances for a short time, gradually increasing the time in low shoes or moccasins. At this time it is of the greatest importance that the patient should have muscular training of the muscles of the foot and leg by means of properly directed and carefully executed exercises. There are two dangers in treatment which are to be avoided: first, that of too long retention by means of tightly fitting apparatus or plaster bandage, especially causing not only muscular atrophy but gluing and adhesions of the transferred muscles; and, second, too early removal of all apparatus with the use of a limb in a faulty manner, especially causing a relapse of the deformity. No fixed rule can be made as to the time during which apparatus is to be worn. The matter must remain to a certain extent to the judgment of the surgeon. It is certain, however, that transferred muscles and ligaments require from three weeks to a month for the first healing. Where the patients are heavy, it is evident that a greater amount of time for the acquisition of former strength is needed than where the individual is lighter, but it is clear that no definite development of strength can take place in the transferred tendons without use. Carefully directed exercises form a most important part of the after-treatment. These exercises should be directed by the surgeon with some care. They can consist simply in walking in the bare or moccasined feet or the use of especially devised appliances which can be made to exercise any muscle in the foot and leg. It may be said that this operation should not be performed in very young children. Some authors claim that it should not be done in cases under six years, but the writers have employed the operation in children as young as four years with apparent benefit. The sloughing out of the tendons, which occurred when the method was first employed by the writers, has not been a frequent incident in the recent cases. In three cases, however, this has occurred without interfering with the obtaining of a useful foot. The cause in these three cases appeared to be the failure to obtain healing by first intention of the wound on the front of the ankle, caused probably by the rubbing of the plaster upon the wound not sufficiently protected and by the fact that the wound was not dressed until some time after the operation, the tis-

sues being exposed to the pressure of dry blood-clot. In one instance a knot of the periosteally inserted silk strand pressed its way through the skin after the healing of the wound and caused a sloughing which eventually necessitated the removal of one of the silk strands. In both of these instances, although the results obtained were not as perfect as far as the restoration of function of the foot is concerned, a strong and useful foot was developed. In two instances periosteal transplantation with artificial silk tendons was employed to correct a relapse following tendon-to-tendon transplantation performed several years before.

The writers are able to draw conclusions from the ultimate results in a number of cases, some of which have been previously reported. It is evident that no conclusions of value can be drawn as to the value of this procedure until the ultimate results, at least a year after the performance of the operation, have been obtained. The writers were able to observe the terminal results several years after the continued use of apparatus in the following cases:

M.—Brought to the writer's attention in 1877, 15 months' child, with a paralytic dislocation upon the pubes of the right head of the femur. After the reduction, which was secured with the employment of much force, apparatus was applied to both limbs, which was changed from time to time. For years the patient was lost sight of, but reported again in 1907, the patient at this time having grown and being able to move about with the use of crutches and apparatus. All deformities had been corrected and the patient was able to walk about the room with some freedom by the use of apparatus alone. As in many of these cases, the patient had become quite stout and suffered from the disability of weight and inability for an active life. There was no arrest in growth in either of the paralyzed limbs and deformities of the feet had been prevented by appliances.

N.—A woman of 34, had worn appliances for twenty-eight years for a paralytic equino-varus of the right foot. She was able to go about with some freedom but, although there was an absence of complete paralysis in the rest of the limb, the muscles of the right limb had not developed in proportion to the increased weight of the patient, and she was able to walk with the aid of a cane with considerable limitation of activity, which increased as the patient grew and increased in size. To relieve this condition an arthrodesis was performed on the ankle-joint with benefit. It

was necessary in correcting the varus deformity to remove a portion of the astragalus and os calcis; the patient was then able to dispense with her crutches.

C.—A woman of 32, has for ten years been obliged to wear a hinged paralytic apparatus reaching from the perineum to the ankle for a paralytic affection of the right limb with which she was attacked at the age of 22. No deformity developed, but almost complete disability of motion at the knee or ankle. The patient preferred the use of appliances to the disability occasioned by a stiffened knee, and has worn without great discomfort a properly applied apparatus with which she is able to carry on an active life.

A case of artificial ligaments operated on four years ago has shown the permanency of the strength of the ligament and the ability to check foot-drop. A child of 8 has also developed to a surprising extent power and ability to raise the front of the foot by the development of the extensor muscles of the foot which were supposed to be paralyzed, although the paralysis had persisted several years before operation was done, demonstrating the fact conclusively that there is a possibility of regaining power in the weakened muscles, if they can be protected from overcoming the strain of the strong antagonizing muscles. The strength of properly inserted artificial ligaments and the restoration of function in transferred flexor muscles of the toes is well illustrated in a man of 23, one year after the operation, where not only was foot-drop prevented, but some restoration of function furnished. In this instance the use of low shoes and gymnastics was enforced four months after the operation.

Although the writers in this paper have referred especially to paralytic deformities of the foot as furnishing the largest contingent of cases for this operative method, they are ready to testify to the value of tendon and muscle transference in other parts of the body. The surgeon has open to him a large field for the exercise of his skill and the development of new methods of operation. Transference of the trapezius in deltoid paralysis has been done by Hoffa and others. Soutter has employed transference of the pectoral into the biceps with success, and also has transferred the erector spinæ, inserting it into the gluteus medius with silk-strand

elongation in a case of paralytic flail-hip from infantile paralysis. The patient a year later had gained adducting power at the hip. Lange has inserted the upper portion of the vastus externus into the gluteus in a similar disability of the hip, and the writer has recently transferred the tensor vaginæ femoris from its function as an internal rotator to that of an external rotator by a silk-tendon insertion into the fascia of the vastus internus. Tubby's operation transferring the pronator radii teres into the supinator radii brevis has been performed with success by several surgeons, and the writers would record four successful cases.

It can be said that surgery in the treatment of infantile paralysis in the last surgical generation has made notable advances. After the neurologist has shown clearly the pathology of the function, the surgeon has been able to prevent the development of deformities, to apply proper prosthetic apparatus and in a number of instances to give to the patients useful limbs as well as a restoration in several instances of the function of which they have been deprived by the paralytic attack. It is not necessary now for a patient attacked by this dreaded affection to anticipate complete disability except in the rare instances in which the attack is so severe as practically to destroy a larger part of the muscles of the frame.

Since the publication of the last list of cases in the *Boston Medical and Surgical Journal* of November 7, 1907, the following twenty patients have been operated upon by the writers.

G.—Boy: valgus, periosteal insertion of the flexor communis.

R.—Valgus, periosteal insertion on the dorsum of the foot of the transferred flexors.

B.—Calcaneo-valgus, osteotomy of the os calsis with correction of deformity and transference backward of the peroneus.

G.—Equino-varus, deformity, artificial ligaments and a transference of the flexor proprius with periosteal insertion on the outer side of the foot.

W.—Paralytic valgus in left varus in right foot. Silk ligaments and transference of the flexors.

O.—Valgus, periosteal insertion of the flexor communis.

T.—Equino-varus, transference and periosteal insertion of the flexor proprius.

H.—Artificial silk ligaments for toe-drop.

D.—Varus, periosteal transference of the flexor proprius.

W.—The same.

R.—Artificial ligament in the foot and transference of the ham-strings forward.

S.—Varus, periosteal insertion of the flexors.

W.—Calcaneo-valgus. Removal of the astragalus, slipping of the foot backward and transference of the peroneus.

C.—Equino-varus, silk ligaments.

B.—Equino-varus, silk ligaments.

M.—Equino-varus, silk ligaments and transference of the flexors.

O. L.—Valgus and varus, flexor transference with periosteal insertion of the flexors.

G.—Transference of the flexors, silk ligament for paralytic varus.

M.—Equino-varus, silk ligaments and transference of the periosteal insertion of the flexor communis.

M.—Transference forward of ham-string tendons on the right side. Transference of the flexor communis on the left side.

Two cases of Tubby's operation are also to be reported.

As only eight months have elapsed since the performance of these operations, the writers are unable to present the terminal results. The present results are very satisfactory.

In conclusion, it may be said that to obtain the best results it is important that there should be a careful selection of cases before operation, that the treatment should be in no sense a routine treatment and that the muscles to be transferred should be selected in each case with care; that the strictest asepsis should be employed; that there should be great care in the treatment both to promote healing by first intention, in protecting the freshly healed tissues from pressure and to prevent the accumulation of serum or blood in the freshly incised tendons; that there should be careful protection from pressure by the use of plaster bandages to the recently incised tendon, that all constriction should be removed as soon as possible and muscular development be aided by the use of gymnastics as soon as possible; great attention should be paid to foot-wear, preventing not only undue strain but also undue pressure; that with these precautions results of satisfactory nature can be expected in a larger number of cases.

III.

A CONTRIBUTION TO THE SUBJECT OF MUSCLE TRANSFERENCE WITH PARTICULAR REFERENCE TO OPERATIVE TECHNIC.*

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Two previous papers on this subject discuss the history and philosophy of the operations and present my position up to about four years ago. I wish to present for consideration work done, ideas gained and principles evolved since that time. In all, this comprises the transferrence of muscles in forty-seven cases.

Most of the work has been done for paralyses following poliomyelitis, although the list includes two operations for deformities resulting from extensive burns by high-voltage wires, one for severe deformity consequent upon extensive destruction from shot-gun accident, two for obstetrical paralyses and one for progressive muscular atrophy of the peroneal type.

Of muscles transferred: Internal ham-strings, one, ten times, two, eight times—the three ham-strings were never transferred together, notwithstanding their grouping; the biceps was transferred with either one or two internal hamstrings eighteen times; the biceps with sartorius twice; the biceps alone, four times into the tibial tubercle and twice into the os calcis; sartorius reimplanted fourteen times; with biceps twice, with tensor vaginæ femoris four times, and alone eight times; the rectus abdominis once. In all, thirty-four operations were made in an endeavor to secure extension and better control of the knee and consequent advance of the limb. Around the foot, the tibialis anticus was transferred twenty-one times, the extensor hallucis twenty-nine times, the tibialis posticus four times, one peroneal three times,

* Candidate's thesis.

both peroneals twice and the common extensor six times. Together, for better control of the foot, forty-four operations were done. In not a single instance was there any dividing of tendons, nor was the Achillis tendon ever transferred (although eleven operations were made for the purpose of better heel control, the tibialis posticus being transferred four times, one or both peroneals five times and the biceps twice). These two points show a definite difference in the planning of operations from that of my earlier work, when tendons were often split or divided and especially slips taken from the tendo Achillis. The flexor carpi ulnaris was changed five times, the supinator longus twice and the pronator radii teres three times. Of unusual reimplantations: the trapezius into the humerus twice (after Tubby's case); the scalenus anticus, in addition, once; the biceps femoris into the os calcis twice (after hearing of Soutter's case of semimembranosus transferrence); and the rectus abdominis into the tibial tubercle once.

I present herewith, in detail, some unusual cases:

A man, some nine years previously, had the whole front of the right forearm torn away by a charge of shot, which took everything in front of the bones from about an inch above the annular ligament up to within three inches of the elbow, including both arteries and portions of the ulna. The wound took about a year to close, several fragments of the ulna being extruded during the process. The result was a rather typical main en griffe, the whole extremity being rigid, cold and atrophied, the fingers and thumb being tightly flexed, the tips of the fingers touching the distal front of the palm. The only motion possible was a slight joggle of the flexed thumb. The man came for amputation, so that he might wear a hook, and thus secure some use of his limb. Instead of amputation the following operation was performed: The scar was dissected, the bones exposed and the muscles of the forearm demonstrated in rather more than the upper three-tenths as clean and as fresh as though just divided. Isolation of separate muscles was not entirely practicable, nor was it absolutely necessary, in view of my belief on the subject as described in my previous papers. Therefore, no tedious dis-

sections were attempted, but double silk (No. 2) sutures were attached by Lange stitch to muscles where recognized, otherwise to approximate bundles of muscles. The tendons were then isolated and recognized as they passed under the annular ligament and their adhesions broken up as far as was practicable. It was possible to free the tendons sufficiently to secure rather more than half normal extension of fingers and thumb. The wrist adhesions were broken up and the whole hand loosened as much as possible. A pair of the silk threads from the muscle above was then sutured by Lange suture to the tendon which nearest approximated its original distribution, and was fastened in a manner later to be described. In this manner, continuity of muscle from origin to insertion was secured for all of the finger flexors, two wrist flexors and one thumb flexor. The wound was closed with some trouble, a few relieving incisions being necessary, and healed nicely. At a few points healing was slow, but at no place was silk or tendon again seen. The hand and wrist were held in the best possible corrective position during the healing process. The fingers could be moved at the first trial, and when last seen, some few weeks before our great fire, the man could easily pick up a handkerchief or a pencil from the table with thumb and fingers, and the function was steadily improving. At that time, about nine months after the operation, the fingers could be four-fifths extended, and all except the little finger could be approximated to the thumb. The motion in the thumb is hard to describe, but it was sufficient to oppose the fingers in picking up small objects. The subsequent history of the man is not known.

Another interesting case was one in which the rectus abdominis was used to advance the leg. Girl, five years of age, with poliomyelitis paralysis of both legs of sufficient severity to prevent child ever getting from sitting posture. On the left extremity there was no discoverable muscle reaction or function except some little power in the internal ham-strings. I took pains to have an independent examination made by a specialist in internal medicine. Thinking it was impossible to secure any control or advance of the leg by ordinary procedures, the following plan was adopted: An incision was made over the lower end of the rectus

abdominis, the anterior wall of the muscles sheath was slit up, the tendon was detached from the symphysis and ramus of the pubis, and a No. 3 double silk Lange suture was fastened into the flat tendon and lower part of the muscle. The silk suture was then passed in front of Poupart's ligament to the lower part of Scarpa's space, then through the sheath of the rectus femoris and out just above the patella, subcutaneously over the patella to the tibial tubercle and usual subperiosteal implantation. The precaution was taken, after lifting the muscle from its sheath, to strengthen the abdominal wall at this point by bringing together the split edges of the anterior wall of the sheath behind the muscle, overlapping them as much as possible, and attaching the sheath with a few quilting sutures to the transversalis fascia behind. An arthrodesis was also made at the ankle to secure stability. Muscle transferrences were also made at the knee and ankle of the right leg. The point to be emphasized is that the child is able to stand on and advance the left limb, and with the aid of a light splint is able to walk all over the house supporting herself lightly on the different articles of furniture which she passes, and she can even take a few steps unsupported. It will be noted in this operation that the silk tendon was passed through the sheath of the rectus femoris, and not subcutaneously, down the thigh. I have performed this maneuver habitually during the last three years in transplanting the sartorius, and have on several occasions passed this muscle through the cavity of the knee, bringing it out above the patella, and have, in two instances, passed the silk from the tensor vaginæ fascia through the rectus femoris sheath in the same manner. Under circumstances in which transplantations are necessary about the knee, the joint is usually an exceedingly wabbly affair, and I have felt that not alone is the centering of the muscle, obtained in this manner, of great value, but also stability and control of the joint are better assured.

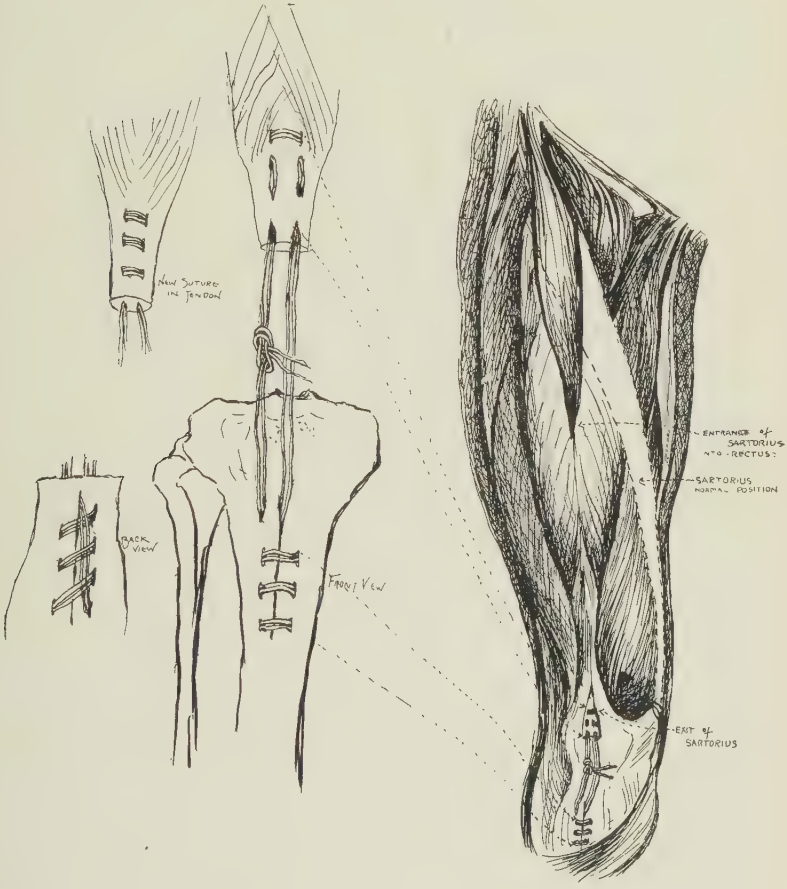
The muscle most difficult to successfully transplant, in my experience, has been the pronator radii teres. This muscle, while easy to locate, has in each instance appeared "unco" short, and its relocation into the radius in such a manner as to favor supina-

tion, or at least not produce pronation, while aiding flexion, has been an arduous task and not so satisfactory as I should desire. Maneuvers practiced on the cadaver have not proven so easy on the operating-table.

Special Technic.—No local preparation until operating-room is reached, then similar "scrub up" that my hands get, viz.: tincture of soap and hot water for ten minutes, three minutes, scrub each with 1–2000 bichloride and alcohol, then flooding with sterile water. No Esmarch bandage is used.

Silk Preparation.—Common twisted silk, Nos. 1, 2 and 3, in one-meter lengths, each piece wound on a glass spool and boiled in 1–2000 bichloride for six minutes and supplied to operator in the vessel in which it is boiled. No hands but those of the operator ever allowed to touch the silk after it has been boiled, it even being held on a bichloride towel by the assistant during its placement. Needles, small, flat, full-curved, threaded with fine, long silk leaders, boiled in water fifteen minutes and subsequently handled with approximately the same precaution as the silk. Silk, threaded to leader with forceps and used double, is fastened with Lange suture (or suture later to be described) to isolated end of tendon to be transplanted, leaving the threaded end not quite long enough to reach the desired site of implantation, the other end being long. The leader is then cut and the needle removed for two reasons: firstly, that one finds it difficult to pull a short, full-curved needle through the narrow subcutaneous passage, and, secondly, we thereby obtain a loop which can later be utilized in fastening the ends of the completed suture by the Blackwall hitch. Both ends of the suture are then passed subcutaneously (or intramuscularly) to the desired region, care being taken, especially when the tendon or muscle follows, that the tunnel is wide enough for its reception. If necessary, two or more points of egress and reentry may be made in the skin to favor path to destination. Here a rather long, longitudinal incision is made to the bone, the periosteum divided and its edges lifted. The long end of the double silk is then rethreaded on a leader and fastened under and into the periosteum with a modified rolling hitch, the last turn of the hitch passing over instead of under the silk tendon,

thus closing the periosteal slit. This suture is made with the requisite tension and pulled snug. The end is then passed through the loop in the short silk end, pulled taut and fastened with a Blackwall hitch. I am especially particular about these



fastenings. They are perfectly safe, give a good hold, are easily applied and lie flat, thereby, from their lack of bulkiness, giving no chance for pressure necrosis and subsequent extrusion. The only knot present is the exceedingly slight one in the Blackwall hitch and that is placed by intent away from the periosteum and

in a region that is more padded with areolar tissue. Diagrams of these sutures accompany the paper. The suture of which I have spoken as a "modified rolling hitch" is a direct complement of Lange's suture and may be advantageously used to replace it when the tendon is short and thick and a grip upon the muscle is advisable. At all times when the silk suture is apt to be exposed around the wound it is wrapped in sterile gauze and the tiny bundle secured with a hemostat. Whenever silk is buried in one place and found to be secure, that wound is closed. Operation is performed with gloves and each step is performed as rapidly as is compatible with proper suturing. Whenever possible, implantations are made where the periosteum is thick and especially at ordinary tendon insertions, though not necessarily at the site of the muscle it is intended to replace, other positions being chosen whenever we think better leverage can be obtained. Of course, it goes without saying that direct implantation of the end of the tendon is made when possible, but with similar precautions and sutured in similar manner as when silk tendon is used.

Result of Technic.—In the forty-seven cases, in which some hundreds of silk tendons have been used, in only one instance has the silk been extruded. This was in a rather heavy girl in whom the peroneals were used to lift the heel, the distal ends of the peroneal tendons being sutured to the common extensor. One of these sutures came out after about ten weeks. In no other instance has the silk been again seen after the closure of the wounds. On the technical side, then, the results have been all that could be expected. On the surgical side, results have usually been obtained bearing definite relation to the plan of the operation, the performance of the work and the length and perfection of the after-treatment. As to the first two points, I have not always planned the work before as well as I could have done after the operation; and it has happened that I have not always been able to do it as well as I had planned. On the whole, however, I feel that I have gotten about what was coming to me. Concerning the third point, the closer control I have had of the patient, the better protection I have given and the longer I have trained the muscles and prevented undue strain and overstretching, and the

more gradually I have given work to the transferred muscles, the greater satisfaction I have had in the end result. The only patient in whom I have not secured a definite improvement was in a young boy (the child of a typical squarehead) over whom I never had the least control. I do not mean to say that I have always been, or ever been, satisfied with results, but on the whole, manifest advantage has been gained and I believe that better planning, more careful work and longer after-treatment will net better results in the future.

IV.

A CONTRIBUTION TO THE SURGERY OF THE PERIPHERAL MOTOR NERVES.*

BY ALFRED S. TAYLOR, M. D., NEW YORK.

During the last decade there has been a marked revival of interest in the applications of surgery to the peripheral nerves. A sound foundation for the work has been laid by careful study of the processes of degeneration and regeneration, and of the results of the anastomosis and crossing of nerves. To the widespread misapprehension of these matters and the fact that results are necessarily slow in appearing are due the lack of interest in this field of surgery.

All observers agree that there is complete degeneration of the distal segment after a peripheral motor nerve is divided. Concerning the regeneration of this distal segment there are two opposing views. The "Peripheralists" assert that it undergoes a process of autoregeneration from the neurilemma cells independently of the proximal stump and the central system. This autoregeneration stops short of the return of function which comes only after the reunion of the distal segment with the central system. The "Centralists" maintain that regeneration comes only as the result of the downgrowth of central axis-cylinders. In a paper delivered before the Harvey Society of New York in March, 1908, Prof. Ross G. Harrison has apparently reestablished the centralist theory on a sound basis.

Whichever of these theories is the correct one, the fact remains that in no case will function return to the paralyzed muscles until the distal segment is reunited to the central nervous system.

* Read by invitation before the American Orthopedic Association at Chicago, June 5, 1908.

Many have lost the benefits of surgical interference from the erroneous and widespread belief that operation, to be successful, must be undertaken within a short time of the onset of the paralysis. There is no definitely settled time limit beyond which operation is contraindicated. Cases are on record where, even after twenty-nine years, operation has been followed by regeneration in the nerve and the return of voluntary control over previously paralyzed muscles.

Of first importance is the condition of the paralyzed muscles, the natural tendency of which is to undergo fibrous degeneration. The rapidity with which this change develops varies very greatly. In every case the muscle condition must be determined by careful electrical tests. When these show absence of muscle substance, operation is futile. When these show presence of muscle substance, operation is indicated, entirely regardless of the duration of the paralysis.

At this point may properly be emphasized the necessity of keeping all paralyzed muscles and joints, by every means at our disposal, in the best possible condition for the day when nerve regeneration shall occur, whether spontaneously or as the result of operation. Failure to do this results in contractures of the muscles and ligaments and maldevelopment of the joint ends of bones, especially in young children, which cause the characteristic deformities in the various types of paralysis. These deformities often become so fixed that it is difficult to overcome them, even by using great force under anesthesia, and it will readily be understood what great mechanical obstacles fully regenerated nerves and muscles have to overcome in order to restore normal mobility in the damaged area.

The field for the application of surgery to the peripheral nerves has been tremendously widened by the experimental demonstration that one motor nerve may vicariously assume the functions of another when they are properly united. Even when the peripheral end of an extensor nerve is united to the proximal end of a flexor nerve, regeneration occurs, and nerve impulses, traveling along the proximal flexor root, cause extension of the extensor muscles. The reverse is equally true. More astonishing still,

when the peripheral segment of a nerve controlling one type of motion is implanted into a nerve controlling the opposite type, the resulting single proximal nerve will distribute both flexor and extensor impulses down the two terminals to the appropriate groups of muscles. This fact is not of much practical value since the two muscle-groups are apt to act simultaneously and neutralize each other.

Kilvington and also Dunlap have shown that when two distal segments are united to one proximal stump, the sum of the regenerated fibres in the two nerves below the union is very much greater than the number of fibres in the single nerve proximal to the union. This increase in fibres below the junction is due to the bifurcation of axis-cylinders in the proximal stump, which Kilvington has demonstrated in a number of his slides.

Nerve regeneration is very much more active in infants and young children than in those who have reached adolescence or adult life.

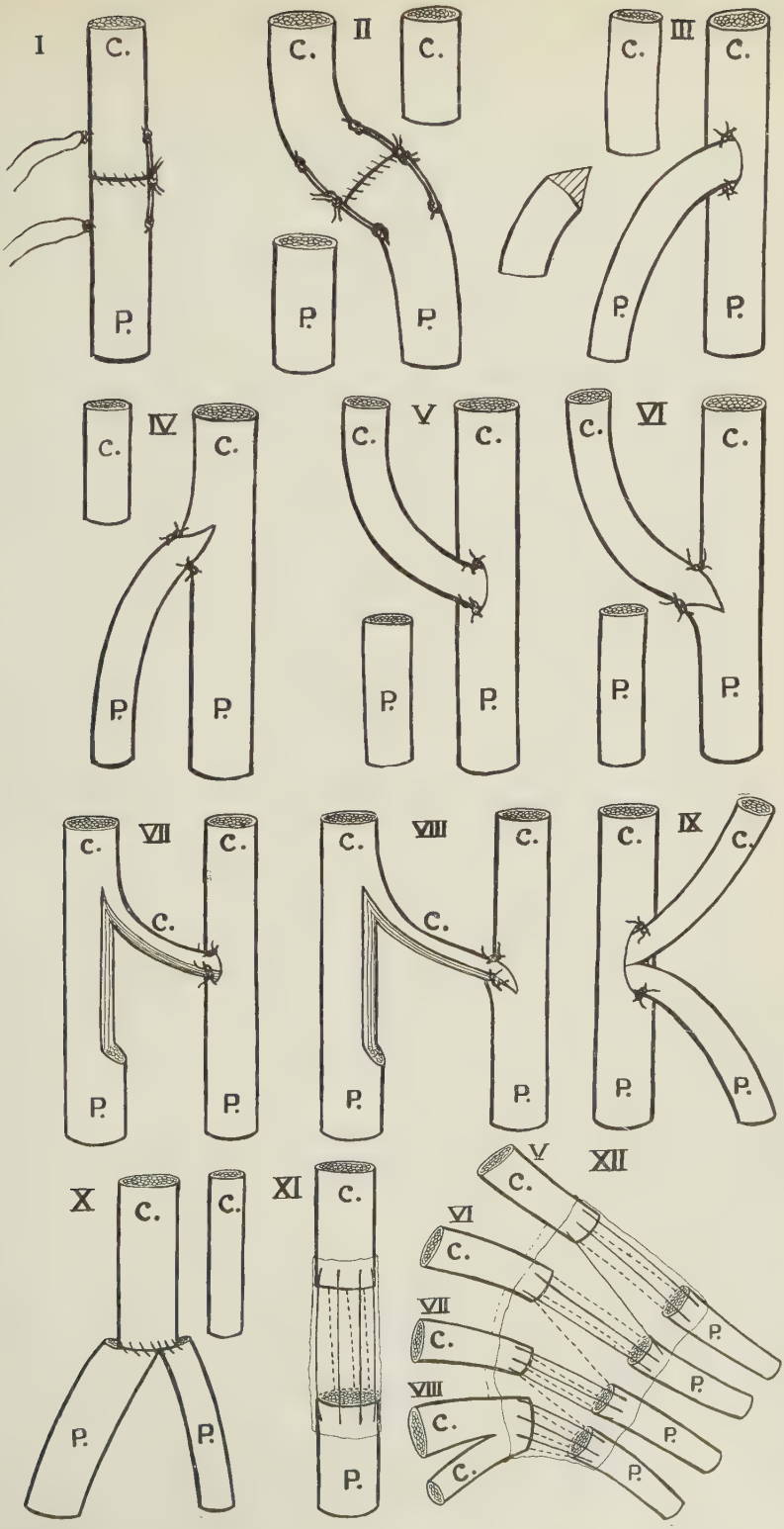
Types of Suture.

From the results of these experimental observations have been deduced several types of operation for the repair of damaged nerves.

A. The ideal procedure is, obviously, to unite, by end-to-end suture, the two ends of the same nerve, after the damaged segment has been removed (Plate 1, Fig. I). Where the ends cannot be approximated,

B. Nerve-bridging, which is only a modification of the end-to-end suture, may be used in suitable cases. The younger the patient and the shorter the distance to be bridged, the greater is the prospect of success. Experimental work indicates that bridging is hopeless when the gap exceeds 4 cm., and even over shorter distances, success has been reported in less than 25 per cent of the cases. "Suture à distance" is the simplest of the various procedures and has so far given the best results in practice. It consists in passing a series of sutures (preferably chromic catgut) between the two ends of the nerve, to act as a frame-work along which the nerve fibres may grow to meet each other. The

PLATE I.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bridged area may be surrounded by some protective (Cargile membrane, Foramitti's prepared calves' arteries, etc.) to prevent connective tissue ingrowth. (Plate 1, Fig. XI)

C. *Nerve Crossing or Transfer.*—When the proximal end of a paralyzed nerve cannot be used for purposes of regeneration, as in facial palsies, poliomyelitis, hemiplegia and extensive injuries, some form of transfer must be employed. For this purpose a neighboring sound motor nerve must be available, and choice must be made between the several methods of transfer.

1. The sound nerve may be divided transversely and its proximal end united directly to the distal end of the paralyzed nerve. (Plate 1, Fig. II.) This method causes permanent paralysis of one muscle-group with the hope of getting a return of power in another which should evidently be of much greater value to the patient to justify the additional mutilation.

The advocates of this method assert that the return of power is more rapid and complete, and that the reeducation of the cortical centres is easier. Certainly, the duty is theirs to show that its results are so superior to those of other methods as to warrant the additional mutilation.*

Theoretically, the end-to-end suture so obtained ought to give a more complete regeneration of the nerve than a lateral implantation, but it remains to be shown experimentally whether the *additional* power so gained is sufficient to overbalance the paralysis caused elsewhere by the division of the sound nerve.

2. Lateral implantation includes a variety of procedures.
   (a) Simple implantation of the distal paralyzed stump into a longitudinal slit in the sound nerve. (Plate 1, Fig. III.) In cases where the paralyzed nerve to be divided has a few active fibres remaining, as in poliomyelitis, hemiplegia, etc., both ends should be implanted into the sound nerve so that the few good

* Part of the delay in the return of control over muscles after nerve-transfer is attributed to the necessity of reeducating the cortical centres to the control of a new set of muscles.

Some authors advise the lateral implantation of the distal portion of the divided sound nerve into some neighboring motor nerve.

axis-cylinders may grow down to rejoin their distal connections. (Plate 1, Fig. IX.)

(b) Implantation of the distal paralyzed stump into a transverse slit in the sound nerve. (Plate 1, Fig. IV.) This really amounts to an end-to-end suture with a portion of the sound nerve.

(c) Partial or complete transverse section of the sound nerve, with the implantation of the proximal segment into either a transverse or longitudinal slit in the trunk of the paralyzed nerve. (Plate 1, Figs. V, VI, VII, VIII.)

(d) Kilvington's method of dividing the sound nerve transversely and then doing an end-to-end suture between the proximal end of the sound nerve and the distal ends of both the sound and paralyzed nerves. (Plate 1, Fig. X.) This combines end-to-end suture and lateral implantation.

The simple implantation of the paralyzed nerve into a longitudinal slit in the sound nerve gives very satisfactory return of motor-power, and causes the minimum of disturbance in the muscle-field of the sound nerve. It should be the method of preference.

The modifications of this method are merely compromises between implantation and transverse section (partial or complete) of the sound nerve followed by end-to-end suture, and are open to all the objections just previously mentioned.

When there is a choice between sound nerves for the anastomosis, that one should be used which has the closest relations, both as o physiological functions and as to the proximity of cortical centres, with the paralyzed nerve, for the return of motor power and the reeducation of the cortical centres will then occur to the maximum degree and with the least loss of time.

Neurolysis, or the release of a nerve from constriction which has caused more or less complete peripheral degeneration, is a procedure closely allied to that of nerve suture, is founded upon the power of nerves to regenerate, and has a wide field of usefulness in posttraumatic conditions.

Nerve disassociation is practically an intraneural neurolysis, in which a nerve trunk is separated into its several bundles to relieve them from the constriction due to increased connective-tissue growth within the nerve itself.

Technic.

In all cases where the sutures will be subject to tension, fine silk (oo or o) should be used because of its reliability. If the suture be coated with vaseline, it will cause the minimum of traumatism to the nerve-tissues. On each side of the nerve, about $\frac{1}{8}$ to $\frac{1}{4}$ of an inch from its divided end, a suture is passed transversely through enough of the sheath to give a good hold and is tied leaving the ends long. The other nerve is treated in the same way and the two ends are approximated by tying together the corresponding pairs of sutures. If necessary, the union may be made more perfect by a fine peripheral suture of catgut or rat-tail tendon. (Plate 1, Fig. I.)

For lateral implantation the nerve end is trimmed to a wedge shape and sutures placed as above. One end of each suture is then passed through its side of the longitudinal slit in the other nerve, and as the sutures are tied the wedge-shaped end of the one is drawn into the slit of the other and snugly held there. (Plate 1, Fig. III.) The wedge-shaped end gives the greatest axis-cylinder contact.

Where there will be no tension, absorbable sutures, fine catgut or rat-tail tendon, which cause somewhat less tissue reaction than the silk, are preferred.

The nerve-sheath should always be trimmed sufficiently to prevent it from crowding into the nerve junction and hindering reunion.

Nerves should always be divided by a sharp scalpel rather than scissors which cause compression damage. They should be manipulated as little as possible, and mainly by grasping the sheath. Sutures should be carried by small round needles, should include only the sheath or should be passed through the nerve-trunk so as to tie parallel to the fibres in order to injure the fewest axis-cylinders. When sutures must include fibres, they

should be tied rather loosely to avoid compression degeneration distal to the sutures.

Cargile membrane or other protective may be wrapped about the junction to prevent the ingrowth of connective tissue.

Opinions differ widely as to when operation is indicated in various paralyses.

When the ends of the same nerve can be brought together there can be no question as to the propriety of operating as soon as the fact of loss of continuity is determined. In all other cases operation is indicated as soon as the probability of spontaneous regeneration in the paralyzed nerve has gone. Authors vary between six months and a year as to the interval which should elapse before operation is advised. No definite rule can be given, for the time must vary with the type of paralysis and the individual case.

So many cases of satisfactory return of power are on record where the paralysis had lasted considerably over a year, that one is safe in following the more conservative course in doubtful cases, provided the muscles are properly cared for in the interval.

Results.

In simple cases of divided motor nerve, followed by fairly prompt suture of the freshened ends, complete *restitutio ad integrum* often occurs. Frequently, however, the result falls short of perfection.

In other types of cases, the results, although often astonishingly good, are never perfect. On the other hand, complete failure seldom follows a well conducted operation on a properly selected case.

The first evidences of nerve regeneration appear in improved sensory and trophic conditions. These are very variable in the time of their onset but they are usually well advanced by the end of three months.

Voluntary motion, except in a few unexplainable instances, never returns sooner than three months after operation, and often only after six to fifteen months have passed. The process of degeneration followed by regeneration which the distal part of

every divided motor nerve undergoes, requires at least three months, so that reports of movement in previously paralyzed muscles within a few days or weeks after nerve-suture are usually the result of faulty observation. These errors are not to be wondered at when the complicated mechanics of motion and the tendency of one group of muscles to vicariously assume the functions of another are considered.

After voluntary motion begins to return, progress is slow but continues for several years. The rapidity of improvement depends upon good after-treatment which has previously been outlined, and especially upon the interest and cooperation of the patient. No stimulus to nerve regeneration equals that of the patient's attempts to send voluntary impulses down the nerve to the paralyzed muscles.

Illustrative Groups of Cases.*

Anterior poliomyelitis, because of its great frequency and bad prognosis, opens an alluring field for the trial of nerve-surgery. Since the lesion is in the cord, only some form of transfer of the paralyzed nerve to a neighboring active one is feasible. Only palsies involving a fairly sharply circumscribed group of muscles are suitable, for where the palsy is widespread there will be no sound motor nerve into which the other may be grafted.

My personal experience is limited to five operations, two on the upper, and three on the lower extremity. Four of the five were unfavorable cases. As a rule, a new procedure must show results in unfavorable cases, in which little harm can be done, before others will subject themselves to the risks of operation.

Two of the cases had complete paralysis below the elbow, which had lasted four and eight years, respectively. The eighth cervical and first dorsal roots were divided close to the spinal foramina and the distal stumps implanted into the junction of the fifth and sixth cervical roots. The case of four years duration, after eight months, showed definite but slight power to abduct and adduct the wrist, to extend the fingers and wrist, and the hand was

*These cases were operated upon and observed in conjunction with Drs. L. Pierce Clark and Thomas P. Prout, neurologists.

warmer and pink in color. At the end of a year the case disappeared from observation before any useful result had developed.

The second case of eight years duration, after three years, has shown absolutely no result.

The other three cases were all implantations of the external into the internal popliteal nerve. The third and fourth cases gave no results.

The fifth case was the only one with favorable conditions. The paralysis had existed only 20 months, was well circumscribed to the external popliteal nerve, the implantation was easily done, the wound healed without reaction, and after-treatment was carefully followed out. After two years, the neurologist reported that there was some nerve regeneration but the muscles were not strong enough to prevent drop-foot. The result was practically negative in a case that was, from theoretical considerations, very favorable.

These bad results are probably due to the fact that the nerves into which we have to implant the paralyzed ones, are themselves seldom intact and do not cause very active regeneration in the paralyzed nerve.

In extensive paralyses of one lower extremity, it may be feasible to expose the cauda equina and implant paralyzed nerves into the corresponding ones of the opposite side.

Hemiplegia.

In 1905 Spiller suggested that the nerve power in the paralyzed extremities of hemiplegics might be redistributed by implantations or crossings so as to relieve some of the troublesome deformities. This was tried in four cases of long standing with well-marked contracture deformities. The results were negative.

To give any degree of success the method would have to be applied as soon as the contractures begin to appear.

Facial Palsy.

Facial palsy may result from traumatism as gunshot wounds, mastoid operations, etc., or from disease as Bell's palsy, extension from otitis media, etc.

End-to-end suture is very rarely possible in any event. My personal preference is for lateral implantation of the facial nerve into the hypoglossal for reasons given in previous publications.

After about three months the face is symmetrical when at rest. Voluntary motion appears first in the lower lip and chin region at about six months and then gradually extends upward, involving the eyebrow and forehead last.

A marked degree of power may be gained in this way, but the face will never be perfect in the sense of complete emotional symmetry.

Brachial Birth-Palsy (Erb's Type).

The brachial birth-palsies of the Erb's type form one of the most important groups of nerve cases amenable to surgical treatment. These cases are common in the pediatric clinics and in the orthopedic clinics, to which the older cases with well-marked deformities finally come.

The lesion is the result of rupture of the brachial plexus nerve-roots and deep cervical fascia from overstretching, and the subsequent cicatrization of the damaged area which prevents the reunion of the nerves. Usually the roots rupture from above downward, and one or all of them give way according to the amount of force involved. Rarely one sees a case where the lowest two roots are chiefly involved. The paralysis varies with the extent and degree of the original injury. It appears at birth, and the extremity assumes a typical attitude.

After a time, usually three months, spontaneous improvement begins in most cases and continues slowly for the first two years, after which it ceases, leaving more or less deformity. In any case in which the palsy has not completely disappeared by the end of six months, there will always be some degree of permanent palsy, and this is most often of the "Erb's upper-arm type."

Since the interference with nerve regeneration and function is due to cicatricial tissue in the roots, the indication is plain for the surgical removal of the damaged area and the end-to-end suture of the central and peripheral stumps. The damaged area is determined by inspection and palpation.

The best time for operation is between the sixth and twelfth month.

In these cases especially must the muscles and joints be kept in the best possible condition by the means previously mentioned, both before and after operation, so that deformities will not occur during the period of waiting for nerve regeneration. Once they develop, the return of free mobility to the extremity is greatly delayed, even after nerve regeneration is complete.

The immediate result of operation is a temporary increase of paralysis, for, in removing the cicatrix a certain number of good fibres are sure to be damaged. This added operative paralysis has always disappeared, usually in about six months. New voluntary motion begins to appear in from eight to fifteen months and improvement continues slowly but steadily for several years. In addition to the return of motor power, there is marked improvement in the growth, color and warmth of the extremity.

The result will never be so good as an undamaged extremity, but will be immensely better than one not operated upon.

In the older cases, with well-marked deformities, the result will be materially hastened, by stretching the contractured tissues under anesthesia, after nerve regeneration is well advanced, *i.e.*, six to twelve months after operation.

V.

VOLKMANN'S ISCHEMIC PARALYSIS AND CONTRACTURE.

BY REGINALD H. SAYRE, M. D., NEW YORK CITY.

As far back as 1875, Richard Volkmann called attention to the bad effects of dressings applied too tight after fractures; and again, in 1881, he gave his further conclusions regarding these cases.

Comparatively few cases have found their way into literature partly from the dislike of reporting results that have been caused by improper treatment, and partly because efforts to relieve the condition have not been very brilliant in the majority of instances.

Powers, in 1905, reported fifty-two cases, but this list should be increased to fifty-three as Henle had two cases of resection of the bones of the forearm while Powers mentions but one. In 1908, Taylor has added seven cases including the one here reported, thus bringing the number up to sixty.

Volkmann reported a case occurring in the lower extremity, a bandage having been applied very tight around the knee on account of a hydrops and allowed to remain in position for three days. On removal of the bandage slight pressure sores were seen, the calf was contracted and painful, and the foot in an equinus position. The foot-drop continued, the contraction of the calf-muscles increasing. On account of this contraction it was only possible to bring the foot to right angles with the leg after the origin and insertion of the calf-muscles had been approximated by flexing the knee. The patient recovered after many months.

In the majority of cases, however, the forearm is affected and the deformity is a claw-hand very similar in appearance to the *Main-en-griffe* resulting from nerve involvement.

Volkmann drew attention to the fact that the cause of the disability in the cases under consideration is primarily a myositis, and that the deformity comes on much more rapidly than when the nerve has been injured. In some cases it is true that we find the nerve compressed by the scar-tissue of the injured muscle but this is a secondary result.

Lesser, in 1884, published the results of experimental ischemic paralysis produced in animals by occluding the arteries by tight bandages.

If pressure is continued for six hours or more the muscle substance rapidly degenerates, a condition of rigor mortis sets in and we may have gangrene and cutaneous blebs. If the pressure is relieved there is marked congestion of the muscles, effusion from the vessels into the muscle substance, and a myositis is set up which later on transforms the muscle wholly or in part into a fibrous cord.

In Lesser's animals, if the constriction was suddenly removed, the effusion into the muscle was great; if the constriction was gradually lessened the effusion was much less.

If the splints were removed from the animals altogether the muscles gradually resumed their normal condition. If, however, they were reapplied even quite loosely there was more or less permanent disorganization of the muscles.

According to Lesser, the nerves did not suffer from the constriction of the limb by tight splints, the muscles alone being affected. Von Frey produced ischemia of the sciatic and later on faradized the nerve and produced contractions of all the muscles supplied by it.

Lapinski, on the other hand, after cutting off all the arterial supply with the resultant acute ischemia found that a trophic disturbance of the nerve substance occurred, with complete atrophy of the muscles, and abolition of the reflexes and disappearance of sensibility.

Clinically we often have the trophic changes in the skin and nails due to nerve destruction associated with the contracture described by Volkmann, and those who have operated on these cases have frequently found the nerves much atrophied. This,

however, has in almost all cases been apparently due to constriction of the nerves by fibrous cords of disintegrated muscle substance and in a few instances by bony callus.

The typical cases are almost all the result of fractures in the upper extremity, the great proportion being the bones of the forearm, and almost all in children.

It is true that at the time of the injury, there may be such damage to the blood-vessels that there may be subsequent contracture of the muscles, but all the cases so far recorded were treated by splints which became so tight in a few hours as to cause swelling of the extremity and the damage was due to this cause. In one case the bones of the forearm were reunited by a callus which was extensive enough to press on the muscles and nerves, but in the majority of cases the pressure has been due simply to the dressings. It is possible to produce a decided interference with the circulation in the forearm simply by flexing the elbow, and this fact should be remembered in treating these cases. In fractures of the lower end of the humerus, if the fragments are not properly reduced, pressure of the bone against the vessels may cause ischemia.

The application of the Esmarch bandage has been responsible for the occurrence of some of these cases. Usually it has been applied while operating, but in one case reported by Bernays, all four extremities were rendered bloodless for six or eight hours in the effort to save a patient exsanguinated by a postpartum hemorrhage, the result being that ischemic contractures set in in all four extremities with a fatal result.

The clinical features of Volkmann's paralysis are as follows: Shortly after the application of the dressings the hand swells, becomes dark, even purplish, and spots may be seen on the skin if the bandage is tight enough and left on a sufficient time. The pain is often most acute and this according to Owen is one cause why so few cases are seen in adults as they cause the dressings to be removed in a short time while the children are compelled to suffer. After a time the pain may disappear to be succeeded by a feeling of numbness as if the hand were "asleep." The bandages are usually then removed or reapplied somewhat

looser and shortly a contraction of the long flexor muscles of the fingers takes place, the hand eventually assuming a claw-like appearance, the wrist being slightly flexed, the proximal phalanges hyperextended on the metacarpal bones and the distal phalanges flexed, this flexion at times being so marked as to drive the nails into the palms.

The lumbricals and interossei are not implicated in the trouble and so when the wrist is sharply flexed it is possible to extend the fingers to a greater or less extent, but as soon as the wrist is again extended the fingers close automatically in spite of all efforts to keep them extended.

The prognosis is very grave and depends largely on the amount of injury which has been done. If the entire body of the muscles has been destroyed recovery is impossible and even with damage of a slighter extent recovery is usually imperfect. It is only in the very mild cases that full function is restored and Volkmann even went so far as to say he had never seen this take place.

The treatment first and foremost is prophylactic. Recognizing the fact that swelling is apt to follow a fracture, splints should be applied sufficiently loose to allow it to take place, and the patient seen at intervals of not longer than four hours during the day. If it is impossible for the patient to be so examined, if a plaster-of-Paris splint has been applied, it should be cut through to the skin from end to end, and the patient's family instructed to gap it sufficiently to relieve the trouble if there should be swelling or pain.

If the patient returns with pain and swelling the splint should be removed. If plaster-of-Paris is used the front of the splint should be taken off and only a trough like a sling left to support the arm, as Lesser's experiments clearly showed that in animals, after the removal of dressings, the muscles speedily became normal if unconfined, while if the dressings were applied even loosely the contractures supervened.

If the case does not come under observation until the contracture has set in several methods of procedure present themselves: Manipulations, massage, faradism and galvanism, and forcible

extension under anesthetics have been tried and have been found almost useless, except in very mild cases.

The trouble being a permanent shortening of the flexors, lengthening of these tendons has been advocated. On account of danger of adhesions forming in the annular ligament, the operation must be well up on the forearm and may consist of

FIG. 1.—Volkman's ischemic paralysis and contracture when first seen.

splitting the tendons close to the remains of the muscle belly and sliding them on each other, or by means of a Z-shaped cut elongating them. There is much danger that adhesions will form between the tendons, making independent use of the fingers impossible, and the tendons sometimes become adherent to the skin wound and still further complicate the matter.

These considerations led Henle in 1890 to shorten the bones of the forearm and so approximate the origin and insertion of the affected muscle, instead of trying to lengthen the latter. His results were more satisfactory than the majority of the operations on the tendons themselves, and his teaching has been followed by a number of operators both in England and this country.

At the meeting of the American Orthopedic Association in 1907, Mr. Robert Jones, of Liverpool, detailed the method which he had used in several cases, and which as far as I know had not at that time been published. Making use of the fact that by flexing the wrist the flexor tendons were relaxed enough to

FIG. 2.—Shows possibility of extending fingers when wrist is strongly flexed.

make it possible to draw the fingers slightly away from the palm, a bent metal splint was applied to the palmar surface of each finger while the wrist was thus flexed. In a few days it was possible to draw the finger still straighter while the wrist was flexed, and the metal splints were straightened accordingly. This method was pursued until the fingers were in full extension while the wrist was sharply flexed. The splint was now carried up on the forearm and the wrist was extended more and more every few days, the finger still being kept in extension. By degrees the hand was brought into extension with the arm and then hyperextended, the fingers meanwhile being kept from

flexion. Later on massage and electricity were used to still further aid in restoring function.

The results reported by Mr. Jones were so excellent that when, in September, 1907, a girl of eleven presented herself at my clinic with a typical Volkmann's ischemic contracture and paralysis, I determined to put this method to the test.

The history was that two years before there had been a fracture of both bones of the forearm which was put up in wooden antero-

FIG. 3.—Hand and forearm secured to palmar splint with flexible rod at wrist to permit gradual change of position.

posterior splints. The hand soon swelled and was painful, but the splints were not removed for four days, when pressure sores were found. The splints were reapplied looser, and the fingers in a short time began to contract, being close against the palm in about seven weeks. They also became cold, blue and glassy and had continued so until coming under observation. At the time I first saw her there was the typical *main-en-griffe* deformity (See Fig. 1) and the fingers could not be separated from the palm without flexing the wrist. The proximal phalanges were hyper-

extended, the knuckles being recessed, while the heads of the metacarpal bones were unduly prominent. A scar was visible on the flexor aspect of the forearm. The flexor muscles consisted of a small ball of flexible tissue near the elbow, and a long, fibrous band which occupied the rest of the forearm.

Not recollecting exactly Mr. Jones' instructions about splinting each finger by itself, I flexed the wrist and extended the fingers as well as I could and put up the hand and arm in plaster of Paris.

FIG. 4.—Hand fastened to palmar splint with wrist hyperextended.

At the end of a week I removed the dressing and found I could still further extend the fingers, (Fig. 2) which I did, retaining them in the improved position by another plaster-of-Paris dressing. This process was continued at weekly intervals until the fingers were straight. The hand was then put in a wooden palmar and forearm splint, the two parts of which were joined by a strap of malleable iron so that extension of the wrist could be made from time to time. (Fig. 3.) By means of this splint treatment was continued until hyperextension of the wrist could be obtained. (Fig. 4.)

At this time massage of the hand and forearm were begun and faradism applied. The child was encouraged to use her fingers, the splint being removed daily for this purpose. It was very difficult at first for her to bend the fingers and very decided force was necessary in giving passive motion, but she can now extend and close them quite well and touch the tips of each finger with the thumb. In this case the thenar and hypothenar muscles were somewhat involved, which is quite uncommon,

FIG. 5.—Extension of wrist with extension of fingers. Contrast improvement with Fig. 1.

and flexion of the metacarpal phalangeal joint of the thumb has been very difficult.

The solid wood-like mass of tissue still persists in the forearm, though it is less extensive than formerly, and the muscles are constantly increasing in size.

It is to be remembered in these cases, as in cases of paralytic clubfoot, that the rate of bone growth is often in excess of the rate of growth of the damaged muscles—and just as we sometimes see cases of talipes equinus recurring after tenotomy of the

tendo Achillis in consequence of this fact, so we may have recurrence of the Volkmann contracture in growing children if gymnastic exercises are not carried out during the period of growth.

The accompanying pictures do not show the deformity as well as they should as they were not taken until after treatment had been begun and it was then impossible to put the hand in exactly its original position. They, however, show quite well the nature of the deformity and the method of applying the wooden splint,

FIG. 6.—Extension of wrist, flexion of metacarpal phalangeal joint, approaching normal. Can touch tip of each finger with tip of thumb. Contrast with Fig. 1.

although the photographing of the earlier plaster splint was overlooked. The improvement has been progressive, and now that splints have been removed from the hand, massage and gymnastic exercises and electricity will be continued for many months, as by this means only can the best results be secured.

In contrasting the various methods it seems to me that each has its own special field of usefulness and in some cases that a combination of methods may be best.

Full use of the hand is now prevented more by the stiffness of the knuckles than by anything else and these joints are becoming daily more flexible under massage.

This is my only experience with the method of Mr. Jones and I was somewhat skeptical about it when I began, but my experience of the very surprising results to be obtained by putting constant traction on resisting club-feet made me willing to try what could be done in this case. The result so far has been as good if not better than might have been secured by open incision.

In cases where the nerves are involved in scar tissue great gain is often had by relieving them from pressure, but there are cases in which more good can be done by the removal of exudates by patient massage than by any other method.

Between bone resection and tendon elongation the choice lies in favor of the former as being easier and shorter and apt to give a better result although at the expense of shortening the length of the forearm. The Jones method avoids the latter deformity and should be given a trial first of all, and if it fails to give a satisfactory result the cutting operations may be still used to supplement it.

A bibliography is added for the benefit of those interested in the subject.

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VI.

PARALYSIS OF THE SHOULDER; WITH ESPECIAL REFERENCE TO ITS MECHANICAL TREATMENT.*

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The purpose of this paper is to analyze the factors contributing to the disability in paralysis of the shoulder, to lay especial stress upon the part played by overstretching of paralyzed muscular tissue, and to present a simple modification in its mechanical treatment, illustrating this by a report of cases.

Paralysis of the shoulder, while arising from a variety of causes in the adult, is in children practically always the result of anterior poliomyelitis or of birth-palsy. Since the points to be presented are the same whatever the cause of the paralysis, anterior poliomyelitis may be taken as the type on account of the excellent opportunity afforded for comparison of the extremities.

Paralysis of the arm in anterior poliomyelitis differs from that of the leg in (1) the less frequent involvement of the arm, the proportion in over a thousand cases being one to four; (2) the greater tendency to recovery, Judson giving the ratio as high as eight to one; (3) the less frequent development of deformity, and (4) the location of the resulting disability.

Into a discussion of the cause for the less frequent involvement, it is not now necessary to go; the remaining points are readily explained by the difference in the requirements of functional use. That the arm possesses a decided advantage over the leg in this regard is at once apparent; the child with a paralyzed leg must bear the entire weight upon it in walking, while the one with a paralyzed arm can, and does, use the sound arm. The very

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moderate demands that are made upon the weakened muscular tissue of the arm are, therefore, only such as favor its development. Further, in the upright posture the hand and the forearm are maintained in the position of rest by the action of gravity; the swinging to-and-fro, which takes place when the child is in motion, is naturally beneficial. Hence, deformity of these parts is not common, while the disability which results from this position is usually manifested only in diminished power of supination at the wrist and flexion at the elbow.

When the shoulder is affected, on the contrary, conditions are most unfavorable, the assumption of the upright posture at once subjecting the muscles and the capsule of the joint to constant strain from the weight of the arm.

The anatomical construction of the shoulder-joint poorly adapts it for maintaining its integrity in the presence of paralysis. The shallow glenoid cavity offers no obstacle to lateral or downward movement of the head of the humerus. The capsule is thin and lax and is adapted primarily "not to maintain apposition but to limit movement, the maintainance of contact between the articular surfaces (being) by muscular action, aided by atmospheric pressure, not by ligamentous or capsular attachment" (Piersol). In order that contact be perfect, the head must be held at the proper level and must be fixed so that lateral motion will be impossible. The weight of the arm is borne chiefly by the deltoid, assisted by the long head of the biceps, the long head of the triceps and the coraco-brachialis, while the fixation of the head in the socket is effected mainly by the rotators, the attachment of some of them (supraspinatus, teres minor and subscapularis) to the capsule aiding very materially in this function. As nearly all of these muscles have the same nerve-supply, the fifth and the sixth cervical, the function of the joint is at once impaired through the gradual yielding of the paralyzed muscles under the weight of the arm, aided to some extent, no doubt, by the downward pull of the unaffected latissimus dorsi. As long as this dragging of the head does not become too extreme, it is not likely, on account of the direction in which the head moves, to cause such overstretching of the short rotators as to

interfere greatly with their function should recovery of the nerve lesion take place; the muscles bearing the weight of the arm, however, are stretched in direct proportion to the degree of sagging of the head, and the deltoid is thus placed at a great mechanical disadvantage in the event of recovery, since before abduction of the arm can be carried out the head of the humerus must be drawn up into proper contact with the glenoid cavity, and in most cases it will be found that when this has been accomplished the strength of the deltoid is exhausted.

That the resulting disability in paralysis of the shoulder is due to a combination of the effect of the paralysis and of overstretching of the weakened muscular tissue and not to the paralysis alone is evident from a study of the nerve-supply and from clinical observation. The fifth and the sixth cervical nerves supply not only the deltoid and the muscles arising from the body of the scapula but also both flexors of the forearm and the supinator longus, while the sixth alone further forms a part of the supply down to the hand. A lesion severe enough to completely paralyze the deltoid, therefore, would be manifested in severe paralysis in other parts of the arm. It is a well-known clinical fact, however, that flexion of the forearm may be almost normal while the deltoid is apparently quite useless.

Hence it comes that, while in the lower extremity deformity and disability are seen most often in the foot, it is the shoulder which is most frequently affected in the upper. The fact that the deltoid is the most likely of all the muscles of the arm to present permanent disability is to be ascribed solely to unfavorable mechanical conditions, just as the tendency of the weighted foot to assume the position of valgus is sufficient explanation for the greater frequency of involvement of the tibialis anticus in the leg.

The disability in paralysis of the shoulder from any cause is the result of (1) direct sinking of the head away from the socket, (2) insecurity of the head and (3) contraction of unaffected muscles, and these are due to the paralysis and its distribution plus the secondary overstretching of the weakened muscles.

That damaged nerve-cells may recover sufficiently to functionate but in the meantime the muscles be incapacitated by

overstretching and atrophy from disuse is to well known to require further mention here. If seen from the beginning of the attack, these evils may be avoided by appropriate measures. When not seen until late in the chronic stage, it is still possible by maintaining the muscles in a position of maximum relaxation, and thus permitting retraction to take place, to bring them up to the highest point of efficiency, which in some cases, at least, will be sufficient to meet the requirements of functional use.

The first to recognize this important principle, as far as I have been able to learn, was C. Fayette Taylor. In a monograph on infantile paralysis, published in 1867, he said, "The ability to restore, partially at least, an enfeebled muscle by persistently relaxing it, is of great importance in the treatment and prognosis of these unfortunate cases." Later the same idea was advanced by H. O. Thomas, who stated, "In all treatises on the treatment of articular deformity, much attention is drawn, very properly, to what the surgeon can, and ought to do in the way of rectifying a contracted muscle; but the following fact has never been recognized, that the art of the surgeon, while extending the range of superior muscles also corrects the elongation of the inferior muscles, which in some deformities it is a matter of great practical importance to recognize." He applied the principle with success to various conditions, and especially well in his treatment of wrist-drop by hyperextension. In a short paper, read before this Association in 1894, Ridlon mentioned this point and laid stress upon the fact that "the successful treatment of these (infantile) cases is the obtaining of structural shortening of the elongated muscles." The most enthusiastic advocate of this method of treatment at present is Robert Jones, who has reported a number of cases of wrist-drop in which dorsal flexion was restored even after years and who has applied it successfully to the elbow by fixing that joint in acute flexion through the excision of a skin-flap.

In the application of this principle of treatment to the shoulder, however, the means used have been, I believe, insufficient. In his monograph, Taylor mentions the use of a sling, and this is practically the only method mentioned to-day in the various text-

books which treat of the subject. Thomas supported the arm by means of adhesive strapping. Various forms of apparatus have been devised by the Germans, but with the object of fixing the head of the humerus more securely. Obviously all of these measures serve only to aid the muscles in sustaining the weight of the arm and, while they may of service in the acute stage, fail entirely to meet the indications for carrying out the principle of maximum relaxation after the muscles have become stretched. Taylor also used some form of brace but the only mention of this which I have found is by Bradford, who, in discussing Monks' paper, refers to such an appliance, which he says was not worn at night; he also mentions one used by Thomas. In 1890 G. H. Monks, of Boston, presented a splint for the treatment of various conditions of the shoulder, including inability to raise the elbow from the side, by supporting the arm at right angles to the trunk. Several years ago I treated a case of paralysis of the shoulder and arm in this position without, as is so often the case, being aware that it had been used before; the result in this instance was partially successful, as the child obtained a much more useful arm and was able to abduct the arm when lying down, although not when standing. Further study convinced me that this position is insufficient, since it fails to give the full amount of relaxation possible for this joint.

In the usual case of paralysis of the arm the tendency, as has been mentioned, is toward diminished or lost power of supination at the wrist, flexion at the elbow, and outward rotation and abduction at the shoulder. This is easily understood when we consider that the fifth and the sixth cervical nerves supply the deltoid, the outward rotators, the flexors of the forearm and the supinators, and further that the position of rest in the erect individual is one of pronation, extension, inward rotation and adduction. In treatment, therefore, the arm must be placed in such a position and to such a degree that these muscles will be given the maximum amount of relaxation. This position is obviously one of supination at the wrist, flexion at the elbow, and outward rotation, abduction and elevation of the arm at the shoulder, thus bringing the palm to rest on the top of the head.

Not only is the maximum amount of relaxation of the affected muscles obtained in this position but it possesses the additional advantage of at the same time providing for the maximum stretching of the unaffected adductors, which is a matter of no small importance.

The most convenient means for securing this position is by a modification of the Monks wire splint, which may be slipped into a pocket in a light canvass jacket. This is light and comfortable, may be easily altered so as to change the position and permits of ready access for treatment (Fig. 1). Supination of the hand is

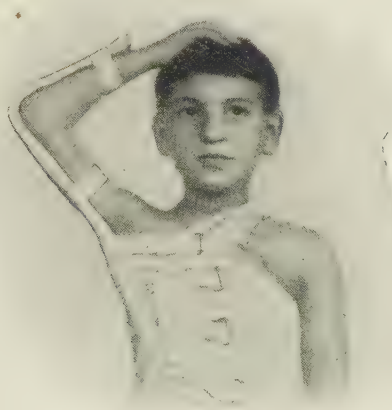

FIG. 1.—Showing the arm held in the position recommended by the wire splint, which is slipped into a pocket in the canvass jacket.

secured by strapping the wrist to the brace in the desired position. In some cases, to be referred to later, where more perfect fixation of the head is desirable, a plaster-of-Paris cast or a moulded leather splint may be advisable.

The rapidity with which the arm can be elevated to the desired position and the modifications in this position which may be necessary vary with the case. In the ordinary case, without much relaxation, only a few days are required to obtain the final position. Where there is much relaxation, however, with contraction of the unaffected humero-thoracic muscles, the problem is com-

plicated by the tendency to displacement of the head downward or laterally. In some instances it may be necessary to maintain the right-angled position until the tissues draw up sufficiently to prevent the head from slipping onto the lower border of the glenoid. A tendency to forward displacement, due to contraction of the pectoralis major, may be controlled by swinging the elbow forward and inward. It is in such cases that the plaster cast would probably be useful, although I have not yet been forced to employ it. Various modifications in the position may also be demanded by the especial distribution of the paralysis.

Any untoward effects, such as numbness of the arm and hand from pressure of the head of the humerus upon the plexus or circulatory disturbances, were not observed in my cases.

The other measures employed in treatment consist of the customary massage, electricity, hot and cold douching, and exercises, both unresisted and resisted.

The brace must, of course, be worn continuously, and the same care is to be observed here as when the method is used in other locations, not to allow the arm to be lowered, even for a moment, from the final position; when the brace is removed for massage, douching, etc., the position may be easily retained by having the child grasp the hair. After the desired retraction of the muscles has been secured, it seems to me advisable to gradually lower the arm to somewhat less than right-angled abduction, as the immediate bringing of the arm down to the side throws too much strain upon the deltoid and is also sometimes painful. The brace may then be removed at night. Finally adhesive strapping, as employed by Thomas, may be applied to give some support to the shoulder or a sling may be used for a part of the day. After-treatment, directed toward the building up of the muscles, must naturally be continued over a long period.

The time required for treatment is probably the same as when the method is used in other locations, that is, from six to eighteen months.

The application of the method would seem to depend more upon the existing conditions than upon the cause of the paralysis. In addition to anterior poliomyelitis, it is apparently equally

applicable in the treatment of birth-palsy, in which, as we know, the fifth and the sixth cervical nerves are again the ones most commonly affected, thus producing the same disability as that described. Naturally not all cases of any form of paralysis can be expected to respond to this method. In some cases the paralysis is so extensive that the remaining power will be insufficient, even when developed to its highest degree of efficiency, to maintain contact between the head of the humerus and the glenoid; in others it may be sufficient to maintain contact but no more; but there are still others in which a greater degree of recovery of the nerve lesion has taken place and in these we can hope to secure a certain amount of active abduction. The use of this method interferes in no way with subsequent muscle grafting or arthrodesis, should they be necessary; it may indeed be recommended as a preliminary measure to muscle grafting, since there will be greater certainty of success from grafting if the remaining power has been developed to its highest point of efficiency.

Report of Cases.

Case I.—Stella A., aged 11 years, entered the Pittsburgh Hospital for Children on August 27, 1907.

Past History.—When 13 months old, she suffered an attack of anterior poliomyelitis of the right arm and leg. In March, 1907, an operation, evidently tenotomy of the tendo Achillis, was performed on the right foot in a New York hospital.

Present Condition.—The right shoulder is held slightly higher than the left and is distinctly flatter, especially on its outer and posterior aspects. When at rest, there is a depression of a finger's breadth between the acromion and the head of the humerus; on attempted abduction the head of the humerus moves upward and this depression disappears. The patient can carry the hand across the body and move the elbow forward and backward but abduction is entirely absent (Fig. 2); other movements of the arm are apparently normal. The right clavicle and the right arm are each three-quarters of an inch less in length than the left; the circumference of the right arm just below the shoulder is one inch less than the left, while the forearms are equal. The right foot is in a position of moderate valgus.

Treatment.—A week after admission, a wire splint was applied and the arm gradually elevated, over a period of several days,

to the position shown in Fig. 1. The brace was removed daily for massage, hot and cold douching, and later for exercise, but during this time the elbow was not allowed to fall below the level of the shoulder.

Subsequent History.—Several times during the course of the treatment the arm was purposely lowered in order to determine progress, a procedure which should not ordinarily be done. As early as ten weeks after beginning treatment, the following note was made, "Can abduct arm from the side by first flexing the elbow and pressing a little with the fingers on the shoulder. Considerable lateral motion of the head of the humerus is present."

FIG. 2.—Stella A. Showing atrophy of shoulder and position of arm during attempted abduction.

The brace was worn continuously for eight and a half months, but during the last four or five weeks of this period the arm was being brought down gradually to a position somewhat below the shoulder level. The ability to sustain the extended arm after eight months treatment is shown in Fig. 3.

Note, September 11, 1908. Since this paper was read the patient has continued under observation; massage and exercises have been used, and the weight of the arm has been removed from the shoulder muscles a part of each day by a sling.

The forearm measures one-quarter inch less than its fellow and the arm at the shoulder an inch and a quarter less, both thus showing a loss of a quarter of an inch, but the shoulder shows a marked gain.

The arm can now be elevated from the side to the normal distance above the head, but the movement is not quite smooth and there is still a little lateral motion. The hand can be carried behind the neck and back of the waist, and can be sustained at the level of the shoulder.

CASE II.—Barbara S., aged 6 years, was admitted to the Pittsburgh Hospital for Children on December 10, 1907.

Past History.—Fifteen months before admission she had a very severe attack of anterior poliomyelitis which affected all the extremities, the trunk and the face. The right arm was not so

FIG. 3. Stella A. Showing ability to sustain extended arms after eight months' treatment.

severely affected as the left and the trunk was only slightly involved.

Present Condition.—The face has completely recovered. The legs are severely paralyzed, so that standing is difficult and walking alone impossible. The right arm has recovered but is weak. The left arm still shows the effect of the paralysis at the shoulder; there is considerable atrophy, the circumference of the arm just below the axilla being one inch less than its fellow and the forearm a quarter less. The arm can be abducted about 45 degrees in the manner shown in Fig. 4, and can be sustained when elevated above the head. Outward rotation is limited but other movements are carried out in the normal range.

Treatment.—This was similar to that in Case I.

Subsequent History.—Three weeks later the child could raise the arm above the head from the side. Fig. 5 shows the ability to hold the arm extended fifteen weeks after beginning treatment, although she was able to do this at an earlier date. In April she developed measles and passed out of our care for a time, being sent to the Municipal Hospital; for this reason and also because the muscles are still improving, the brace has not been removed.

Note, September 11, 1908. Since this paper was read the patient has remained under observation; as in the preceding case,

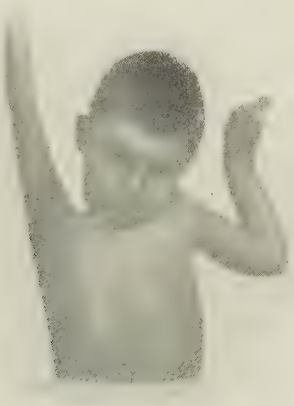

FIG. 4.—Barbara S. Showing best position in abduction before treatment.

massage and exercises have been used and the arm carried in a sling for a part of each day.

The forearm measures a quarter of an inch less than its fellow and the arm at the shoulder three-quarters less.

The arm can now be elevated from the side above the head and can be sustained at the level of the shoulder; the hand can be carried behind the neck and the waist; outward rotation of the arm has been restored. The improvement has, therefore, been considerable, although elevation is not yet so smoothly performed as on the other side.

CASE III.—G. E., male, aged four and a half years.

Past History.—Paralysis of the right arm about three years ago. This was the patient in whose treatment I had used the position of right-angled abduction with benefit.

Present Condition.—Supination is limited. Flexion at the elbow is weak. The arm can be abducted when lying but not when standing.

Treatment.—This was similar to that in Case I.

Subsequent History.—In this case the shoulder was severely affected and the joint very much relaxed. Considerable difficulty was experienced in preventing displacement of the head both forward and downward, yet with care it was possible to maintain it in a fairly good position.

FIG. 5.—Barbara S. Showing ability to sustain extended arms after fifteen weeks' treatment.

After several months treatment, however, it was evident that not enough muscular tissue remained to ensure a result by this method and the brace was accordingly discontinued. The tissues of the shoulder retracted well and held the arm in a slightly better position when it was brought down to the side. This case is apparently one in which arthrodesis will be indicated when the proper age has arrived.

CONCLUSIONS.

1. The disability in paralysis of the shoulder, from any cause, is due not only to the paralysis itself but to overstretching of the weakened muscular tissue, the anatomical construction of the joint being such that it is poorly adapted for maintaining its intregrity in the presence of paralysis; the fact that the deltoid is

the most likely of all the muscles of the arm to present permanent disability is to be ascribed solely to unfavorable mechanical conditions.

2. *In so far as this disability is the result of overstretching*, it may be overcome by the application of the principle of maximum relaxation of the affected muscles. Since impairment of supination at the wrist and flexion at the elbow are often associated with the disability at the shoulder, the position suggested for carrying out this principle is one of supination at the wrist, flexion at the elbow, and outward rotation, abduction and elevation of the arm at the shoulder, thus bringing the palm to rest on the top of the head; an additional advantage of this position is that it provides for maximum stretching of the unaffected adductors.

3. Since this method is a conservative one, its use is recommended in all cases not known to be completely paralyzed. While in some cases the paralysis is so extensive that the remaining power will be insufficient, even when developed to its highest degree of efficiency, to maintain contact between the head of the humerus and the glenoid and in others it may be sufficient to maintain contact but no more, yet there are still others with a greater degree of recovery of the nerve lesion in which a varying amount of active abduction will be secured. The use of the method is also recommended as a preliminary measure to muscle grafting.

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VII.

REPORT OF CASES OF TYPHOID SPINE.*

BY GEORGE B. PACKARD, M. D., DENVER.

The painful sequel of typhoid fever known as typhoid spine continues to be regarded with a great deal of interest, although the number of cases found in literature is now fairly large. The fact that the pathology is still somewhat obscure adds to the interest in these cases. I desire, therefore, to place on record several cases that have come under my observation since the original paper on this subject by Dr. Gibney.

Case I.—In November, 1898, Dr. J. B. Devlin, of Denver, asked me to see a boy of nineteen years of age who was convalescing from typhoid fever. The prominent and characteristic symptoms of typhoid fever had been present, the diagnosis was considered positive. During the eighth week he began to complain of severe pain and tenderness in the back. Attempts at motion in any direction were very painful. Muscular rigidity was well marked. There was no special pain along the course of the sciatic or anterior crural nerves. There was no kyphosis. He had failed to get relief from internal or external medication. I applied an anteroposterior support, which afforded relief in a comparatively short time. This treatment was continued for nearly a year and he was under observation ten months longer. There was no recurrence of symptoms.

Case II.—In October, 1899, J. C., of Leadville, Colo., twenty years of age, consulted me on account of painful spine. He had just recovered from a very severe attack of typhoid fever. There had been an epidemic of typhoid fever in Leadville during that fall and the cases generally were severe. Although it was the ninth week, he still had some daily temperature. Pain in the back and chest was very severe, especially following slight move-

*Read before the American Orthopedic Association at its twenty-second annual meeting, held at Chicago, June 4–6, 1908.

ments. The muscles in the lumbar region were very rigid. Knee-jerks were exaggerated. A plaster jacket was applied, but failed to give relief; in fact, both pain and temperature were increased for several days. A Taylor brace was applied two weeks later, and in the course of one month he was entirely relieved from pain, but reflex muscular spasms remained. This treatment was continued for ten months. There was no recurrence and no deformity.

CASE III.—In January, 1904, I saw, in consultation with Dr. P. D. Rothwell, of Denver, a man thirty-eight years of age, always healthy and robust, until he had typhoid fever in a severe form four months previous. He was in bed eight weeks. After being up a few weeks be began to have pain in his back, with spasm of the muscles, and was compelled to remain in the recumbent position. The pain soon became very excruciating and the slightest motion would bring on violent spasm of the muscles and great suffering. The knee-jerks were exaggerated. There was no kyphosis. Salicylates, counterirritation and rest in bed for several weeks failed to give any relief. With considerable difficulty I applied a plaster jacket, but with very little relief. Two weeks later I applied another jacket, and in the course of four weeks he was free from pain. This case was kept under close observation for one year and seen occasionally since. He has never had a recurrence of these symptoms; there is no deformity, but there is rigidity.

CASE IV.—E. J., aged thirty years, tramway conductor, was referred to me by Dr. H. G. Harvey, of Denver, in December, 1906. He was taken with typhoid fever about the 1st of October, 1906, and was in bed eight weeks. The attack was severe, and after being up two weeks he began to have pain and stiffness in the back, which gradually increased. While the suffering was not so severe as in the preceding cases, the pain was referred to the sides and front of the body. The plaster jacket gave relief in a few weeks, although the treatment was continued for six months. There has been no deformity or recurrence of symptoms.

CASE V.—C. K. was admitted to the Denver City and County Hospital in September, 1907, with typhoid fever. The attack was rather severe, but nothing unusual. He left the hospital Nov. 1, 1907. Soon after he was discharged from the hospital be began to suffer with his back, and was treated for several weeks by his family physician. His symptoms continued to increase, until he was readmitted to the hospital in January. He was now suffering most excruciating pain, the slightest motion bringing on paroxysms, lasting for several minutes. His back was very

rigid. Pain was referred to the region of the hips, and there was a slight projection at the eleventh and twelfth dorsal vertebræ. A radiogram taken by Dr. Stover shows the space between the eleventh and twelfth dorsal vetebræ to be less clearly defined than the other intervertebral spaces. A plaster jacket was applied, and in course of a few weeks he was relieved. A Taylor spinal brace has since been applied. He is now absolutely free from pain, but some rigidity and slight projection remain.

After carefully observing the symptoms and results of treatment in the preceding cases, I cannot regard any of them as neuroses, which has been suggested by Dr. Osler in his papers on typhoid spine. When one of the prominent symptoms is muscular rigidity and the relief from mechanical treatment is so pronounced, the orthopedic surgeon would hardly regard such cases as neurotic, especially if there were no recurrence of symptoms.

Many of the cases mentioned in this paper came under treatment comparatively early. This is no doubt an important factor in preventing deformity, as the inflammatory process would be more quickly checked. On the other hand, cases where treatment has been delayed may show evidence of organic change in the vertebræ and a resulting deformity.

I believe these cases should be regarded the same as cases of infectious arthritis, the severity of the symptoms depending upon whether the typhoid bacillus is present in the tissues involved or whether some toxins of this organism have lodged here. Dr. Goldthwait has explained these variations in symptoms in his article on infectious arthritis, and it seems very plausible that, if the typhoid bacillus has found lodgment in any of the structures of the spine, it might produce sufficient damage to cause organic change, suppuration and more or less deformity, while on the other hand, if the process be due to the presence of the toxins of this organism, the symptoms would be milder and probably not result in organic change or projection.

Most of these cases under present consideration did not develop any kyphos. This result I am inclined to think is due to the fact that they came under observation and treatment very early.

Only one resulted in slight deformity, and this case was not treated mechanically for some months after the onset of acute symptoms. In regard to the symptoms, pain in the back from the slightest movements has been more constant than neuralgia or referred pain, and muscular rigidity has been more pronounced than in ordinary tubercular cases. It would seem that there was a good deal of voluntary rigidity from apprehension, and no doubt the unusual prominence of this symptom has led some writers to regard the trouble as neurotic, but after this condition is relieved we find a regular involuntary muscular spasm that does not yield for several weeks or months.

While this group of symptoms may vary in severity in different cases, I believe they represent one condition rather than several, as has been suggested by some writers. I cannot regard any of the cases that I have seen as functional, but in all instances I believe the pathological findings would depend upon the extent of inflammatory action. There has been no history of injury in these cases, unless there was a strain from early activity before they had regained their strength. None of them had any trouble whatever with the spine previous to the development of typhoid fever, neither have they had any recurrence of these symptoms subsequent to the attack described.

There are some points of interest that are brought out in the treatment; they are also of some diagnostic value. Probably the diseases that are most likely to be mistaken for typhoid spine are neurasthenia, tubercular spine and lumbago. The latter can generally be excluded from the fact that it is transient and apt to recur. It has not been my experience to see the immediate relief from fixative appliances that I have observed in tubercular cases; in fact, the first effects seem discouraging and in some instances it seems to aggravate the symptoms, but in nearly all cases within a few weeks the relief is very pronounced. In three of my cases I should have been inclined to abandon mechanical treatment during the first two weeks, had I not been confident of ultimate relief. This peculiar condition during the early mechanical treatment I feel is indicative of the absence of tuberculosis, and when good mobility returns after a few months of mechanical

treatment (as it frequently does), it is further evidence of a non-tubercular condition.

There is nothing so unsatisfactory in my experience as trying to relieve neurotic symptoms by fixation. Even if we obtain temporary relief, relapse is certain in a short time.

The pronounced relief from fixation in typhoid spine and the absence of recurring symptoms present the strongest possible evidence, to my mind, that this group of symptoms known as typhoid spine is not a neurosis.

VIII.

ACTINOMYCOSIS OF THE RIBS AND VERTEBRÆ.*

BY DR. JAMES K. YOUNG, PHILADELPHIA.

The rarity of actinomycosis in man and the exceedingly fatal character of the affection are sufficient excuse for the report of a case that has recently come under my observation.

A lawyer, 39 years of age, in good health and of good heredity, except that his father had died of phthisis, was seized with difficulty of deglutition in November, 1906. He lived in a beautifully located valley town of Pennsylvania, and had no knowledege of having been exposed to infection by cattle suffering from "lumpy jaw" or "swelled head." The trouble entirely disappeared at the end of ten days. Four months later he complained of severe pain in the left shoulder and in the middle of the back, at the inner upper angle of the left scapula. The left side of the neck and shoulder became enormously swollen, with stiffness of the neck. The swelling extended to the mid-scapular region and an incision in the median line posteriorly liberated about ten ounces of pus. Subsequently the swelling in the neck, which appeared at this time to be glandular, suppurated and was incised.

The disease was not arrested at this time and, as the patient became greatly emaciated and anemic and the suppuration continued, he came under my observation at the University Hospital the latter part of May, 1907.

The examination of the blood, pus, and urine at the time of his admission gave the following: The blood showed hemoglobin, 65 percent; red corpuscles, 3,800,000; white corpuscles, 13,440. The pus contained staphylococci, and streptococci, but no tubercle bacilli. The urine showed a specific gravity of 1010, and was negative for albumen, sugar and casts.

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Examination of Patient.—He was greatly emaciated, having lost 150 to 160 pounds; the pulse was rapid, 106–120, and feeble; the evening temperature was 101°; the lips were pale, and the skin, pale and white.

The examination of the spine revealed no bony kyphosis, and the movements of the spine were normal. The muscles of the neck were contracted, particularly on the left side. There was some induration between the incisions and some induration over the side of the neck but groups of individual glands could not be detected by palpation. There was no tenderness. There was a

Actinomycosis of vertebræ.

sinus on the side of the neck discharging very small quantities of pus and the lower sinus was discharging profusely.

There was a swelling 15 cm. in diameter, the centre of which was at the lower incision between the angles of the scapula. The examination of the chest and pharynx was negative. There were night-sweats with insomnia. The radiogram taken at this time revealed a superficial lesion of the angles of the second and third ribs on the left side, but no other lesion of the vertebra.

The specific character of the inflammation not having been determined, I decided to remove all the diseased portions as thoroughly as possible, including the scraping of the ribs. The peculiar situation of the disease of the ribs beneath the left scapula led me to make several dissections on the cadaver in

order to diminish the size of the wound necessary to accomplish this, and to avoid the spreading of the inflammatory process. The operation was undertaken five days from the date of his admission to the hospital.

The incision was T-shaped, the original lower wound being enlarged and supplemented by a lateral incision. An extensive pultaceous slough of the entire area was thoroughly removed for a distance of 23 cm. in a vertical direction and extending laterally to the angles of the ribs on the left side. A counterincision was made 5 cm. below the original incision and through-and-through drainage was established. The lateral incision was partially closed with sutures in order to prevent infection, and no subsequent infection of this region occurred.

The examination of the scrapings from the central wound gave the same findings as the examination of the pus from the same but the examination of the scrapings from the ribs by means of cultures, made by Dr. John M. Speese of the Pepper Clinical Laboratory, revealed the presence of actinomycosis. The colored drawings were made from the cultures obtained in this manner. A foreign body, resembling a piece of straw, was found in the bone sinus but was not preserved.

The patient reacted well from the operation, the temperature being normal and the pulse remaining rapid. Subsequently for weeks the evening temperature remained at 99°, the noon temperature reaching 101°. The opsonic index taken the day after the operation, while waiting for the report from the Laboratory, showed an index for streptococcus of $5\frac{8}{10}$ and for staphylococcus of $4\frac{8}{10}$, each about one-half of normal. An injection of serum, 10 millim streptococcus and 50 millim staphylococcus, was given. One week later the leukocytosis was 12,800 and two weeks later the reaction remaining low, a subsequent injection of serum was not given.

He was much improved by the operation and returned to his home the latter part of June, the treatment being the use of iodide of potassium in large doses and the aseptic dressing of the wound, together with the use of tonics.

The exfoliation of the skin and the injection of the conjunctiva produced in cattle by the use of iodide of potassium was not seen.

Three months after his return to his home, as he did not tolerate the iodide of potassium well he returned to the hospital for a short time and the iodide of potassium was administered by cataphoresis. This did not control the disease and it spread to the right side of the neck, several nodules forming, and upon

incision the pus was found to contain the characteristic yellow sulphur bodies described by Bollinger as typical of this infection. The nodules continued to extend in different directions, suppuration continued, and seven months after the operation the patient died from pyaemia. There was just prior to death a blocking of the venous circulation. At no time did the brain become infected, and at no time did physical examination reveal any lesion of the chest.

The postmortem examination of the dorsal region showed many small and larger abscesses in the muscular tissue and intermuscular tissue beneath the periosteum from the first cervical to the first lumbar vertebra. These abscesses varied in size from one-fourth inch to one inch in diameter.

The tenth dorsal vertebra was denuded of periosteum and communicated with a large abscess cavity.

The second and third ribs on the left side from the scrapings of which the diagnosis was made, were whole and unaffected by disease.

No examination of the internal organs was made.

The spinous processes from the lower dorsal vertebra were examined by Dr. Speese of the Pepper Laboratory, who reported as follows:

"I find on examining the portion of bone removed from the vertebral column that it is the seat of an inflammatory process resulting in destruction and thinning of the bone, and in the production of inflammation. There are several well-defined bodies which I believe to be the ray-fungus, and I, therefore, have no hesitancy in making the diagnosis of actinomycosis."

IX.

CONGENITAL SCOLIOSIS.*

REPORT OF CASE.

BY NATHANIEL ALLISON, M. D., ST. LOUIS.

The study of numerical variations in the bones of the vertebral column and of malformations and deficiencies in the vertebræ has thrown considerable light on a group of cases that were all supposed formerly to be acquired. Emphasis has been laid by many observers in the last decade on the importance of the rôle played by these prenatal conditions in the production of scoliosis. Special stress has been laid by Böhm[1] on the importance of numerical variations as a causative factor in the development of habitual scoliosis. Radiographic examination has established a variation at the primary seat of deformity in 16 of the 24 cases he examined. Bardeen[2] has established the percentage of numerical variations in spines as from 15 to 16 percent.

Coville[3] examined 1015 new-born infants and discovered scoliosis in but one child, confirming the statement advanced by Böhm that these curves, even when due to congenital defects in development, often are not manifest until growth has considerably advanced. Lovett[4] states that the two most common locations of congenital defects are the cervico-dorsal and lumbar regions and that they depend clinically on the following conditions: Cervical ribs, lumbar ribs, extra lumbar vertebræ, sacralized vertebræ and deficient vertebræ. Spina bifida and spina bifida occulta are often associated with these defects when located in the lumbar region.

Codivilla (*Gaz. hebd. med. et Chir.*, July 7, 1901, p. 637),

*Read before the American Orthopedic Association at its Twenty-second Annual Meeting, held at Chicago, June 4–6, 1908.

FIG. 1.—Skiagram of case showing numerical variation of vertebræ in the lumbo-sacral region of the spine.

reported an interesting case due to faulty segmentation of vertebræ in the lumbar region wherein the defect consisted of an additional half vertebra between the second and third lumbar. He claims the distinction of making the diagnosis for the first time on the living—thanks to the radiogram. This case was not associated with any trace of spina bifida occulta.

FIG. 2.—Compensatory lateral deviation of the spinal column due to congenital variation in the vertebræ of the lumbo-sacral region.

The cause of these developmental errors is a matter of surmise. Regarding it, Dwight makes the following statement: "The cause of the original error is as yet undetermined, but there is no reason to suppose that it is either hereditary or a step toward the future."

The case I wish to report is that of a girl of six years, first seen in October, 1906. The child's mother has severe scoliosis of right dorsal, left lumbar type with marked rotation. This developed during adolescence. As soon after the birth of the infant as possible, the mother examined her spine and discovered a slight curve in the lumbar region. The child was otherwise perfectly healthy and well formed. The parents think that this curve has increased during growth and have noticed a compensatory curve in the dorsal region. Aside from this, development has been normal and she has been an active and

healthy girl. No treatment for the correction of the deformity has been undertaken.

Physical examination revealed a well-developed and well-nourished girl; heart and lungs normal; extremities of equal length; there is no sign of rickets. In standing, there is an apparent inequality in the height of the anterior superior spines of the ilia and of the angles of the scapulæ. The spine is flexible to a normal degree in all directions. There is a marked lumbar curve to the right and a long dorsal curve to the left, unaccompanied by marked rotation. The dorsal curve can be easily overcorrected but the lumbar curve remains fixed. A radiogram of the entire spine reveals the following conditions: 1, A marked lumbar curve to the right; 2, a decided insufficiency of the right sacro-iliac articulation; 3, a marked deformity of the last lumbar and the first sacral vertebræ; 4, a compensatory deviation to the left in the dorsal region of the spine. The lumbar region of the spine on palpation reveals no cleft or evidence of spina bifida occulta.

The radiogram in the case clearly establishes the diagnosis as one of congenital scoliosis, depending on anomalies at the sacro-lumbar region of the spine—these anomalies consisting of a variation in the symmetry of the last two lumbar vertebræ with fusion and asymmetry of the first and second sacral vertebræ. These variations are joined with a marked deficiency of the sacro-iliac articulation on the right side.

Treatment.—It was found that an elevation of three-quarters of an inch under the left lower extremity slightly overcorrected the dorsal deviation. A plaster cast was taken of the child's trunk, holding the lateral deviation of the dorsal region overcorrected, and on this a light celluloid apparatus was made, which has been worn constantly for the last year and a half. Daily exercises to increase the flexibility of the spine have been carried out. At the last examination, two months ago, the child showed a marked increase in spinal flexibility and a good physical development. The lumbar-sacral curve shows no increase, and the general attitude in standing is much improved.

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SPECIAL ARTICLE.

CONGENITAL ELEVATION OF THE SCAPULA.—SPRENGEL'S DEFORMITY.*

ALEXANDER EARLE HORWITZ, A. M., M. D., ST. LOUIS, MO.

Definition.—Congenital elevation of the scapula is an affection characterized by an upward displacement of one or both scapulæ, with rotation upon the sagittal or frontal axis. Alterations in shape, size and density of the bone exist.

History.—Attention was first directed to this deformity by Eulenberg, in Germany, in 1863. He reported three cases of "hochgradige Dislocation der Scapula," one of the left and two of the right shoulder. Dorsal scoliosis with convexity away from the deformity existed in one. There was no rotation of the scapulæ.

In 1880 Willet and Walsham, in England, described a case of congenital elevation of the shoulder which came to autopsy. The left scapula was connected, by a broad osseous band, with the spinous process of the sixth cervical vertebra, and differed in shape and size from its fellow. Four and a half vertebræ, five right and four left ribs were absent. Rotation of the scapula with a sharp left dorsal curve existed. A second case with similar symptoms was reported by the same authors in 1883.

In 1888 McBurney and Sands, in America, each presented a case of "Congenital Deformity Due to Malposition of the Scapula." They ascribed the malposition to the curving of the superior border of the scapula. Sands resected the curved portion and succeeded in bringing the scapula down.

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In 1891, Sprengel, in Germany, again drew attention to this deformity by describing 4 cases of "Angeborene Verschiebung des Schulterblattes nach oben." Upward displacement of the scapula without rotation existed in each case. He advocated a plausible theory for the existence of this deformity, and "Sprengel's Deformity" has become a synonym for this condition. Other writers rapidly followed, and Zesas has, in 1904, collected 100 cases from literature.

In 1899 Honsell, in Germany, reported the first case of bilateral elevation and was followed by Milo, Hirsch and others. Fourteen cases have been reported to date.

In this paper we shall summarize 120 cases collected from literature, to which we have added 16 unpublished cases.

Normal Anatomy.—The scapula is a large, flat, triangular bone, situated upon the posterior aspect of the thorax, extending vertically from the second to the seventh or eighth dorsal vertebræ, with its median border parallel to the vertebral column. The vertical diameter exceeds the one drawn at the base of the spinous process, the ratio between them, called by Broca the scapular index, being expressed as follows:

$$\frac{100 \times \text{breath}}{\text{length}}$$

For Europeans this index is, according to Broca, 65.91; Flower and Garson, 65.2. For negroes, 68.16 and 71.17, respectively. For anthropoid apes, the following table is of interest:

	Flower and Garson.	Broca.
Chimpanzee,	69.9	68.52
Gorilla,	72.2	70.38
Orang-outang,	77.6	69.27
Gibbon,	96.5	96.97

The index for the European expressed by Dwight, based upon the largest and most select number of cases, is 63.5.

With slight variations, these researches show that the higher the grade of evolution, the lower the index (the diameter parallel to the spinal column being longer).

Upon the ventral surface of the scapula a transverse depression

is seen, corresponding to the spinous process on the dorsum. This is the subscapular angle, formed by the bending forward of the supraspinata upon the infraspinata, and averages, according to Ward, 129¼ percent. Upon the dorsum of the scapula the angles formed by the supraspinata with the spinous process (the supraspinous angle), and the infraspinata with the spinous process (the infraspinous angle) average 132¾ percent and 98¼ percent, respectively. Quain gives the following: "The supraspinous angle (between the prescapula and mesoscapula) measures about 100 percent; the infraspinous and subscapular angles each about 130 percent."

Musculature of the Scapula.—The most important muscles acting upon the scapula are the trapezius, levator anguli scapulæ, the rhomboids, pectoralis minor and serratus magnus. The trapezius is of great importance in holding the scapula in its normal position. It antagonizes the levator anguli scapulæ and has been found atrophied in cases of acquired elevation of the scapula (Bender, Krecke). This muscle has, in its three parts, different functions; the fibres of the lower third hold the scapula down and toward the median line. Henle states that it is the office of the trapezius to draw the scapula toward the spinal column.

The latissimus dorsi, in passing over the inferior angle, assists in holding the scapula against the thorax (Treves).

Development of the Scapula.—The scapula, in its development, appears in the human embryo in the fifth week (Bardeen and Lewis). The arm bud appears in the third week as a slight swelling opposite the fifth to eighth cervical and first dorsal or thoracic myatomes. As development proceeds the shoulder gradually migrates caudally until the adult position is attained. In twelve human embroyos (three to seven months) examined in the Museum of Prof. Minot at the Harvard Medical School I have found this condition to exist. Two are as follows:

1. Fetus, 3 months, superior angle at fourth cervical vertebra; spina scapulæ at sixth cervical vertebra; inferior angle at fourth dorsal vertebra. Spina scapulæ is directed downward and outward, making an angle of 45° with the vertebral column. The superior angle is ¼ inch from the spinous process of the vertebra,

the inferior angle ½ inch. Length of scapula 2.4 cm.; width, 1.4 cm.

2 Fetus, 4 months. Length, 9½ inches, superior angle at sixth cervical vetebra; spina scapulæ at first dorsal vertebra; inferior angle at sixth dorsal vertebra.

Superior angle ½ inch from the spinous process of the vertebra, inferior angle 1 inch. The supraspinata is bent forward, making an angle on the infrascapular surface of 100°. Length of scapula, 3 cm.; width, 2 cm. (Fig. 1.)

At birth the horizontal diameter exceeds the vertical (Fig. 1),

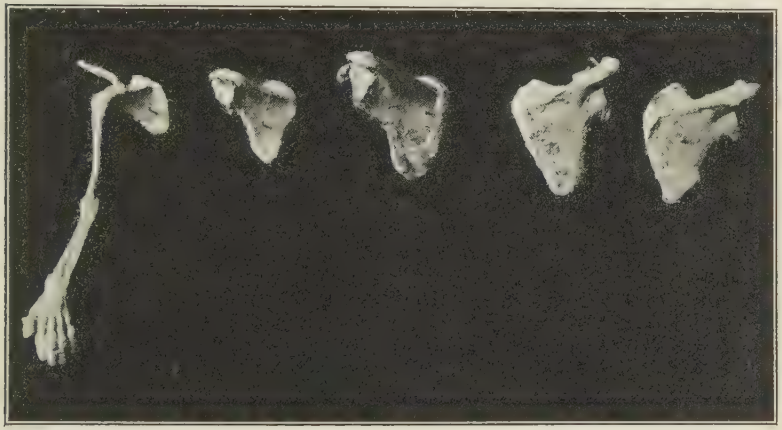

Fig. 1.—Scapulæ from human embryos, three to six months, showing gradual change in relation of diameters.

the ratio gradually diminishing until adult life is reached (Morris), when the reverse is true. In lower vertebrates this infantile condition persists throughout life. In these the diameter along the spinous process is the longer. This exists in the evolutionary scale as high as the apes. In the quadrupeds it is markedly so. In the horse the scapula is a long, narrow bone placed horizontally. Dwight states that "in quadrupeds it is evident that the long diameter of the bone should at least approximately coincide with the line of pressure, and consequently we find the breadth, i.e., the line along the base of the spine, the longer. In erect man with his great range of movement of the anterior extremities, there is

need of greater leverage for the movements of the scapula, and less need of resistance to pressures, so we find a long and narrow scapula."

"The scapula of man is remarkable for the development of the postscapula (infraspinata) making the ventral border very long and the inferior angle very prominent. This is an adaptation to the freedom of movement possessed by the upper limb. The surface for the attachment of the rotator muscles is thus increased, and greater leverage is given to the lower part of the serratus magnus muscle, which rotates the scapula upward." (Quain). This is in conformity with the law expressed by Wolff, "Every change, in the form and function of the bones or of their function alone is followed by certain definite changes in their internal architecture, and equally definite secondary alterations of the external conformation, in accordance with mathematical laws."

Gegenbaur states that the most important of the changes occurring in the scapula in the evolution of the primates is the enlargement of the base of the scapula. Owen states that "the peculiarities of the human scapula are its great breadth (the distance from the superior median to the inferior angle) in proportion to its length, the more transverse direction of the spine and acromion, and the disproportionate extent of the subspinal as compared to the supraspinal tract. The upper angle is less rounded, the extent of the upper border between the angle and the suprascapular notch is relatively greater and more straight; the notch itself is smaller and deeper." Parker states that the small size of the prescapular region (supraspinous portion) and the greater size of the acromion are features in which the embryonic shoulder-blade differs strikingly from that of the adult.

Chievitz, cited by Rager, gives a concise statement of the condition present in the full-term human fetus *in situ:*

"The most striking points in connection with the shoulder-girdle are the high position of the bones and the attitude assumed by the scapula, the body of which lies much more nearly in a sagittal plane than is the case in adults, owing to the shape of the upper thorax. The resemblance between the human fetus and quad-

rupeds in this peculiarity in the position of the scapula has already been pointed out by several authors.

"The scapula lies upon the posterior-lateral aspect of the thorax over the prominence corresponding to the position of the lung; it is inclined to the sagittal plane at an angle of about 22° in the horizontal section, and its upper part inclines slightly toward the median plane. It is rotated so that the glenoid fossa is directed markedly upward and the inferior angle is carried forward. The triangular surface at the inner end of the spine lies close beside the transverse process of the first dorsal vertebra and the inferior angle reaches the lower border of the fifth rib at a point about 15 mm. external to the angle of the ribs. The coracoid and acromion processes and the greater part of glenoid fossa are placed above the level of the first rib and the outer extremity of the clavicle is directed markedly upward. In conformity with this disposition of the bones, the passage from the neck to the axilla is situated high up and the nerves of the brachial plexus, instead of taking a descending course, pass outward into the limb in an almost horizontal direction. The position of the scapula just described, whilst it differs from that met with in adults, in whom the bone extends from the second to the seventh rib, is one that is constantly observed in younger fetuses (for instance, in the one measuring 13 mm., figured by His).

"In fact, the upper limb is, in its origin, a cervical appendage, and retains a position throughout fetal life indicative of that origin; and it is not until the beginning of the extrauterine life that mechanical influences come into play and induce permanent modifications of the fetal condition."

Pathology.—The affected bone differs from its fellow in

a. The changed relation of the diameters to each other;

b. The curving of the superior border or bending forward of the supraspinous portion;

c. The prolongation or the rounding of the superior median angle;

d. The presence of exostoses and articulations with the vertebral column.

(*a*) *Diameters.*

Sprengel, in his description of the deformity, declared that no change existed in the shape or size of the scapula. Subsequent observers have, on the contrary, noted variations both in shape and size. The scapula changes from the shape found in the quadruped to that of the human due to changed demands made upon it. The greater range of motion in man requires a longer and narrower bone. The muscles play a part in this evolution, and the absence or weakness of some of the scapular muscles in nearly every case is undoubtedly a factor. Of the 136 cases in our tabulation, the change in relation of the diameters existed in 53, or 39 percent. It would probably have been found in all cases had observations been made. These were distributed as follows:

Alteration in either diameter,	53—39	percent.
Alteration in both diameter,	38—28	percent.
Alteration in length,	12— 8.8	percent.
Alteration in width,	3— 2.2	percent.
Total,	136	

One case of total absence of the supraspinata has been reported by Kayser, one of the infraspinata by Cauture.

These alterations consist of a diminution in the vertical diameter, or an increase in the horizontal, the reverse not being observed. Where either or both diameters are changed, the result is constant, i. e., an increased ratio, indicating a reversion to a lower type or a retention in the fetal form. How early this arrest of development takes place, we do not know. This ratio obtained in the asymmetrical scapula, ranges from 90 to 110, as compared with 69 to 83 on the unaffected side. Too great value cannot be laid upon the exactness of these ratios as the measurements were taken *in vivo*, whereas those of Broca *et al.* were taken upon denuded bone. A divergence must necessarily exist. The main fact remains, that the relation of the diameters to each other has been altered and the ratio thereby increased.

(*b*) *Curving of superior border and bending forward of supraspinata.*

This was seen in 25 cases or 18.5 per cent. In one case (Ehrhart) the entire supraspinata was bent forward to such a degree that upon palpation it appeared to be lacking. Its true nature was ascertained at operation. Several observers have reported a thickening of the superior border. This is probably a primary curving followed by a secondary osseous hyperplasia. An increase of the subscapular angle is very frequently seen, caused by the bending forward of the supraspinata. A shortening of the supraspinata (5 cm.) is reported by Kayser, shortening of the infraspinata by Rager.

The curving of the border and the entire prescapula is, in all probabilities, not due to pressure exerted *in utero*, as claimed by Rager, but is part of the phenomenon due to the failure of descent. The sheet theory of Dr. Minot will assist in explaining this condition. The scapula originates in the cervical region. Failing to descend, the upper portion of the supraspinata may develop in the contour of the surrounding structures and become curved.

This curved condition is found to an exaggerated degree in the scapula of the ornithorynchus paradoxus studied at the Boston Museum of Natural History, and also mentioned by Parker. In two embryos (four and five months) I have found the prescapula bent forward, forming a subscapular angle of 100. The superior border of one was greatly curved. (Fig. 2.) I am of the opinion that at a certain period in the embryonic stage, perhaps 4 months, the supraspinata is bent forward, from which position it gradually recedes to attain the postnatal form. If these two embryos merely presented a variation from the normal, it is likewise of interest in showing its possibility and early appearance. The curving of the superior border, the maldevelopment of the supra- and infraspinatæ and the increase of the infrascapular angle have therefore some significance.

(*c*). *Prolongation or rounding of superior median angle.*

Eighteen and one-half percent (25 cases) show a definite bony prolongation at the superior angle or the upper third of the median border, 1 to 4 cm. long, confirmed by the radiogram. In several an exostosis was palpable but not so confirmed on account

of the radiability of the cartilage. Many likewise show a broadening of the superior angle which we have shown to be normal to the lower vertebrates (Owen). A hooked-like appearance of the angle was noted by some (Arnold *et al.*).

The early observers mistook the prominent angle for an exostosis and attempted to resect it (Hoffa, Kölliker).

(*d*). *Exostoses and Articulations.*

Twenty-five percent (thirty-four cases) show a bony, fibrous or cartilaginous attachment of the scapula to the vertebral column. Twenty-seven of these were bony. This usually runs from the

FIG. 2.—Scapula from foetus four months, showing curved superior border and curved supraspinata.

superior median angle or the upper third of the median border to the transverse process of a cervical (fourth to seventh) vertebra. In one case (Lameris) a strong band ran from the base, at the inferior angle, to the fourth dorsal vertebra. The osseous union is usually by means of a triangular-shaped bone (Case V, Fig. 12), whose base rests upon the scapulæ and the apex upon the transverse process of the vertebra. Its union is either by means of cartilage at one or both ends (Willet and Walsham, Goldthwait) or by direct bony growth without cartilaginous intervention. Steele reports one case of ligamentous union. The band of

Lameris was, at operation, found to be the degenerated lower portion of the rhomboid. It was white, glistening, and pencil-shaped, 7 mm. broad. The upper portion of the muscle was normal. He termed this condition "myositis fibrosa."

What is the origin of this bony articulation? It is a primary or secondary growth? These articulations, according to Rager, must be regarded as abnormalities, having no direct connection with the high position, as the other defects (hernia, adenoids, etc.,) do. He says that cases have been reported of such articulations without high shoulders, These, I believe, may have been secondary growths, due to some inflammatory process, analogous to myositis ossificans. Willet and Walsham, in their discussion, prefer to believe it a primary growth. They form three hypotheses from which they argue:

"1. That the bone was formed in connection with the vertebræ, and afterwards became anchylosed to the scapula.

2. That it was originally a scapular element, and secondarily became fused with the spine.

3. That it was formed independently both of the spine and of the scapula.

On the first hypothesis the bone may be—

1. An outgrowth of the spinous process or of its epiphysis.

2. An overdevelopment of one of the lateral backward projecting processes, called hyperapophyses, developed near the extremity of the spinous process.

On the second hypothesis it may be—

3. An overgrowth of the epiphysis, which existed at the posterior border of the scapula; in other words, a supra-scapular bone. The scapular arch consequently presents an example of a reversion to a lower type, viz.: that of the skate or frog tribe.

On the third hypothesis it may be—

4. An ossification of one of the intermuscular planes of connective tissue stretching between the spine and the scapula.

5. A rudimentary scapula, explainable on the theory that the embryo was originally cleft, and that by atrophy and by fusion with the other half, one half had disappeared with the exception of the scapula which remains as the bridge of bone."

They consider the suprascapular theory the preferable. Their second case differed from the first in that the union of the bridge of bone to the scapula was cartilaginous, in the first osseous. They argue in favor of a suprascapula from:

"1. The apparent continuity in the first specimen of the bridge of bone with the suprascapular epiphysis, of which it appears to be an outgrowth.

2. Its cartilaginous attachment in the second specimen to the scapula (central piece).

3. The absence of analogy between these cases and exostoses, and the impossibility of explaining how, if they were exostoses from a vertebra, they could have become secondarily attached to the scapula.

4. The insertion of certain muscles into them, showing that the abnormality occurred at a very early period of development.

5. The abnormal condition, in the first specimen, of the scapula itself, and the presence of concomitant malformation of evident congenital origin."

"This growth differs from a spinal exostosis in that it is not covered with cartilage except where united to the scapula, in its flattened condition, in its growth in only one direction, and in its broad base of attachment to the scapula."

This bridge of bone is (in their opinion) an "abnormal development of the suprascapular epiphysis, which normally exists as a narrow ridge of bone along the posterior border of the scapula, and consequently as homologous to the suprascapular bone of some of the lower vertebrates. The suprascapular epiphyses in man may actually present an abnormal backward development comparable to that, say of the rabbit. It is advancing, therefore, but one step further to compare the bridge of bone in our specimens to the distinct suprascapula of the frog, and but one step

further still to conceive it united with the spine, as in the skate. This means that the shoulder-girdle in these cases has reverted to that of a lower type."

"It has existed unossified from the time of the differentiation of the cartilaginous shoulder-girdle from the mesoblast, and having an attachment to the spine from the earliest period. Cervical rib is an analogous overgrowth."

That this bony growth is of suprascapular origin, we may grant, but its union with the spine, if a reversion to the skate, must presuppose the skate to be in a line of descent of the human being. A. Milnes Marshall, in the above discussion, does not think so. In his opinion the junction to the spine may be secondary, due to attrition. The opinion of Dr. Minot is of value. He thinks that the scapula, as other structures, is developed in a sheet. This sheet is continuous with that of the vertebræ, and centres of ossification appearing between the two points, a continuous band of bone is formed. It is more rational to suppose this articulation as originating in the process of development than that it be due to attrition between the elevated and projecting scapula and the vertebræ. Were it due to friction, the growth would be bony throughout, whereas, where it does exist, the articulation is by means of cartilage at either or both ends. This would tend to strengthen the theory of Minot. A suprascapula, if we regard this overgrowth as such, would extend from the lower portion of the scapula, whereas this extends from the upper third, with a broad base of attachment. Lameris is of the opinion that all articulations may be degenerated muscle-bands. "Es ist sogar moglich, dass die Fälle, in welchen eine knocherne Brücke zwischen Schulterblatt und Wirbelsaüle bestand so zu deuten sind, dass im M. Rhomboideus eine Verknöcherung aufgetreten sei."

(*e*) *Defects of Ribs and Vertebræ.*

This is found in five of our cases and in seventeen of our tabulation, a total of 22, or 16 percent. Of these, two (Kayser and Ehrhardt) presented cervical ribs on the side away from the deformity. Both of these likewise showed a kyphosis, the latter a cervico-dorsal scoliosis. Spina bifida in the cervical region

was observed in 5 (Rager, Sick, Graetzer, Hibbs, Horwitz). Those of Sick and Graetzer were in bilateral cases. Spina bifida occulta (second lumbar to sacrum) was noticed by Sick in a second case. Deficiency of ribs and vertebra was reported by Willet and Walsham; displacement of the spines with fusion, by Hibbs; fused and irregular ribs, by Fairbanks; missing ribs, by Graetzer, Fairbanks and Milward. In those of Froelich and Lamaris the intercostal spaces were uneven. Rudimentary third rib, fourth free from sternum, and fusion of first and second ribs were reported by Schelssinger.

(*f*) *Defective Musculature.*

The trapezius is the muscle most often affected. According to Kausch, this muscle, if carefully examined, will be found weak in every case. In two bilateral cases he found complete absence of the left trapezius with atrophy of the middle and lower thirds on the right side. In a third case and in two unilateral cases the trapezius was defective in its lower part. Complete absence was also reported by Kirmisson and Jouon. Weakness of this muscle existed in 46 or 33.8 percent of all reported cases.

The pectoralis major was completely defective in case 7 of our series and in that of Schlessinger, partially defective in two others (Graetzer, Zesas). Complete absence of the sterno-mastoid was observed by Kayser. Among the other muscles affected are the serratus magnus (8), levator anguli scapulæ (6), infraspinata, latissimus dorsi, teres major, pectoralis minor (complete absence—Schlessinger) and rhomboid.

Muscle defect, accompanied by defect of ribs or vertebræ, was observed 8 times; in the remaining 14 cases of rib defect no defect of muscle existed.

(*g*) *Humerus and Clavicle.*

In 18 cases (13.2 percent) shortening of the humerus on the affected side was reported. This varied from ½ to 1 cm., the maximum given by Hibbs. The clavicle was shortened in 12 cases (8.8 percent), malformed in 8 (6.8 percent), did not articulate with the acromion in one (Gourdon) and was 1½ inches longer in the case of McBurney, a total of 16 percent. The shortening of the humerus is usually of too high a grade to be

ascribed to atrophy of disuse, and we are strengthened in this belief by the fact that the forearms in all these cases are, without exception, of equal length. The malformation or shortening of the clavicle is clearly of congenital origin. The growth of the clavicle can proceed only as the scapula recedes, and where the scapula remains high the clavicle must of necessity be shortened. This shortening is noticed as early as the malposition of the scapula.

(*h*) *Attendant Deformities.*

Excluding those defects already discussed we find concomitant defects in other parts of the body in 21 cases, or 15.4 percent. These are distributed as follows: talipes equino-varus, 3; pes valgus, 3; hallux valgus, 1; shortening of femur, 1; shortening of left leg and foot, 1 (Honsell, bilateral); congenital dislocation of the hip, 2 [one on side of elevated scapula (Santru), one on opposite side, (Sainton)]; defect of hand or fingers, 2; radial defect, 2; dislocation of radial head, 2; maldevelopment of the whole upper extremity, 2; bifid ear, 1 (Steele); cleft palate, 1; extremely arched palate, 2; adenoid vegetation, 3; strabismus convergence, 3; underdevelopment of mamma on side opposite to elevation, 1 (Wolfheim); supernumerary mammary gland on side of affected scapula, (Horwitz) 1; subcostal tumor, 1; displacement of heart to right, 2 (Froelich, Schlessinger); floating kidney, 1 (Hoedlmoser); double congenital inguinal hernia, 1 (Rager); left congenital inguinal hernia, 1 (Rager); anal ectopy with incomplete atresia, 1 (Kirmisson).

These defects are more frequently seen on the side of the elevated scapula. Of those which can be classed with either side (18 in number) eleven are toward the side of the deformed scapula, seven on the opposite side. Including all deformities under the other headings, muscular weakness and contractions excepted, 92 or 67.5 percent of all cases presented some attendant defect. This percentage is too great to be ignored. Its cause is to be sought deeper than in the mere fact that a scapula is mechanically elevated or prevented from descending. That there is some general disturbance in which the scapula participates must be acknowledged.

Symptoms.

(*a*) High position of the scapula.
(*b*) Rotation of scapula upon its sagittal or frontal axis.
(*c*) Scoliosis.
(*d*) Torticollis, caput obstipum, facial asymmetry.
(*e*) Motions of scapula and scapulo-humeral joint.
(*f*) General health.
(*g*) Description of deformity.

(*a*) The position which the scapula occupies in relation to the vertebral column varies. It may be found 1 to 12 cm. higher than its fellow, the average being 3 to 5 cm., extending from the fourth cervical to the fourth dorsal (2 to 4 vertebral bodies higher). Froelich reported the highest elevation, 12 cm., in a youth of 16, Pischinger 11½ cm. in a girl of the same age. The heights observed at the different periods are:

Age.	No. of cases.	Average height.	Minimum.	Maximum.
1–5 yrs.	22	3.4 cm.	1.0 cm.	5.5 cm.
5–10 yrs.	20	3.5 cm.	1.0 cm.	6.5 cm.
10–15 yrs.	23	4.1 cm.	1.1 cm.	7.0 cm.
15–20 yrs.	8	5.8 cm.	2.5 cm.	12.0 cm.
20–30 yrs.	6	4.3 cm.	1.5 cm.	6.5 cm.

According to Ehrhardt, the degree of elevation may proceed parallel with the growth of the body. From the above table we note that at each successive lustrum the average, minimum and maximum heights increase. At the age of 20, when the body has attained its full growth, the average recedes or becomes stationary. The scapula retains its infantile shape and size and does not participate in the general body-growth.

The height of the affected shoulder is not always equal to the difference in height between the two scapulæ. This may be accounted for partly by the shortened vertical diameter and partly by the bending forward of the supraspinata.

(*b*) The scapula is frequently rotated upon the sagittal axis. No rotation existed in Sprengel's cases. This was likewise observed in twelve of the reported cases, 33 were, however, rotated, 37 were brought nearer to the spinal column, 8 receded

from it. The other writers made no mention of the position, probably because of its normal relation.

In many of the reported cases the point is emphasized that the inferior angle is more distant from the median line than its fellow. Kausch ascribes this to the congenital defect of the trapezius which permits the scapula to recede. In the fetus the median border at its superior end forms an angle with the spinal column, the inferior angle being further from the median line than the superior angle. This recession of the lower end of the scapula in cases of elevation is therefore a retention in the fetal position, the defective trapezius being unable to draw it toward the vertebral column.

According ot Ehrhardt, the rotation follows the weight of the arm, diminishes the elevation and lessens the cosmetic disturbance. Lameris claims that the alterations in the rhomboids are accountable for this rotation.

Rotation upon the frontal axis, causing the bone to become winged, is probably due to defects of the serratus.

Rotation upon the sagittal and frontal axes are seen in both the congenital and acquired forms, due to the same causes (Bender, Gross, Kausch, Ehrhardt *et al.*). This is not a normal fetal condition.

(*c*) In sixty-five cases (47.8 percent) a scoliosis, varying from a slight to a marked structural double curve, was reported. It is usually cervical and high dorsal with a compensatory lower dorsal or lumbar curve. Cervical lordosis was also observed in one case by Sick. Four presented round shoulder with scoliosis (Graetzer, Perman, Ehrhardt and Nové-Josserand), two without scoliosis (Rager, Nové-Josserand). Ehrhardt reported one case of dorsal kypho-scoliosis, Kayser and Jones each one case of dorsal kyphosis, Lamm one of cervical-dorsal kyphosis. In the remaining cases no deviation existed, or the author made no mention.

The convexity of the lateral curve may be either toward or away from the high shoulder. Of the sixty-five cases showing a curve, thirty-one (22.8 percent of the total 136) were toward the deformity, twenty-one (15.4 percent) away from it, seven

not mentioned; six were in bilateral elevation. Of these six bilateral cases ($42\frac{6}{7}$ percent of the total 14) the curves were distributed as follows: right dorsal, 1; left cervical, right dorsal, 1; right cervico-dorsal, left dorsal, 1; right dorsal, left dorso-lumbar, 1; right dorsal, left lumbar, 1; one not designated. In the unilateral cases we therefore find the curve move frequently toward the deformity. In bilateral cases the main curve is to the right, with the left shoulder usually higher.

Both sides are equally prone to scoliosis. Of the unilateral, twenty-seven, or 45.16 percent were male, thirty-two, or 54.84 percent female. The bilateral were equally divided, three, or 50 percent of each.

The question now arises, is the curvature primary, or secondary to the elevated shoulder, and what relation do they bear to each other? Why is the curve now toward, now away from the deformity? Kausch is of the opinion that the scoliosis is not primary to, nor collateral with the high shoulder, but that it is secondary to the high shoulder, caused by an attempt to straighten the body. Mohr believes that the scoliosis is due to contractions, atrophy and defects of the musculature. Nové-Josserand thinks that the elevation and scoliosis are independent of each other, and coexistent with deformities elsewhere in the body.

That the scoliosis exists in but 47.8 percent precludes the theory that it is primary to the high scapula. In a primary structural curve the elevated scapula would always be found on the side of the convexity. We see, on the contrary, that the curve may be found either toward or away from the high shoulder. Kausch's opinion is likewise untenable. It would, if true, be found in all cases or to a greater number than is actually seen. Mohr's view is plausible. That of Nové-Josserand offers the best solution. That the scoliosis is an attendant deformity, caused by the same general arrest of development, will become evident. The curve seen here must be regarded as of the congenital type. This type is now recognized by Lüning and Schulthess, Lovett and others. An able theory has been advanced by Böhm who ascribed it to a numerical variation of the vertebræ. A vertebra, transitional in character, disturbs the

normal equilibrium of the entire column, causing a curve. In cases I, II, III, VII and XVI of our series, and in several of the reported cases, vertebral, rib and muscle defects existed. These defects can disturb the equilibrium and produce a scoliosis *in utero*, or *post partum* when uneven atmospheric pressure is brought to bear upon the chest. The scoliosis may appear, according to Lovett, when the child begins to walk, due to superincumbant weight. This is seen in cases not severe enough to produce a curve in the recumbant position.

In our cases the degree of curvature is severe and out of proportion to the scapular elevation whereas in the majority of reported cases the reverse is true. It is usually noticed very early and must be regarded as a concomitant deformity.

(*d*) Torticollis is seen in fourteen cases, or 10.3 percent; seven, or 50 percent male; seven, or 50 percent female; five, or 35.7 percent right; seven, or 50 percent left; two in bilateral elevation. The deformity is in all cases on the side of the elevated scapula. Facial asymmetry, atrophy or flattening of either side, was observed in twenty cases (14.7 percent). Ten cases (7.4 percent) presented malformation of the cranium.

Torticollis without facial or cranial asymmetry was observed in six cases, facial or cranial asymmetry without torticollis in sixteen, torticollis combined with asymmetry of face or cranium in five. Of the 14 bilateral cases, six, or 42.8 percent were accompanied by facial asymmetry.

These observations show that the caput obstipum and facial asymmetry are not dependent upon the torticollis, and are not secondary to the elevated scapula, but are, like the scoliosis, an attendant, collateral deformity whose etiology is analogous to that of the elevated scapula.

(*e*). The motions of the scapulo-humeral joint are usually free. A grating noise is frequently observed (Kirmisson *et al.*) due in all probability, according to Tridon, to roughening of the acromioclavicular joint. Limitation of abduction of the arm was observed in 67 cases (50.7 percent). In these cases the arm could not be carried beyond the horizontal. This limitation is in all probability due to the mechanical obstruction offered by the

contact of the displaced superior angle against the vertebral column. The scapula was by Tridon and others found immovable, due to contracted musculature or bony union.

No limitation of motion is observed in many of the early cases, probably due to the fact that no use is being made of the arm at that period.

(*f*). The general physical condition of the patient is usually good, the percentage of weakness or ailment not exceeding that found in any equal number of children chosen at random. Ten cases ($7\frac{1}{2}$ percent) were of poor physical condition. This included one case of hysteria, one of enuresis and one of organic cardiac disease from early childhood. In addition seven (5 percent) suffered from rickets acquired after the scapular defect was noticed.

(*g*) From the symptoms described we may draw a composite picture of this deformity.

1. *Unilateral.*

The patient presents an asymmetrical appearance, one shoulder, preferably the left, being higher. The neck on that side is fuller and shorter than on the other; the muscles are tense; the head drawn to side of deformity with chin on chest; the clavicle placed obliquely upward and outward, frequently at an angle 25–30 percent from the horizontal; the cervico-scapular line is diminished; the superior portion of the supraspinata and the superior angle are palpable in the supraclavicular space; true torticollis often present; facial asymmetry with atrophy of one side with or without torticollis; the eyes may converge; asymmetry of cranium; cervical and dorsal scoliosis with convexity toward or away from the side of deformity, usually not of a severe type; kypho-scoliosis is rare; the shoulder is elevated, at times almost to the occiput, and nearer the median line; the arm is rotated, usually outward; movements of the arm are free except abduction, which in most cases is not beyond horizontal. The mobility of the scapula is lessened. The scapula is rotated, in one of many ways: 1. upon the shoulder joint as an axis, with the external border placed horizontally and the upper portion of the scapula forced into the supraclavicular space; 2. the lower angle may be drawn toward the vertebral column and the upper angle away from it; 3. the

upper angle close to the column and the lower angle away; 4. the entire median border widely separated from the spinal column, the plane of the shoulder blade being sagittal instead of frontal and the shoulder well forward; 5. the entire scapula brought nearer the spine; 6. upon a frontal axis, producing a winged appearance, its lower portion away from the thorax and its upper portion forward.

The amount of elevation of the scapula ranges from 1 to 12 cm., with a mean of 3 to 5 cm., the shoulder usually not showing as high an elevation as the scapula. Instead of occupying its normal position, second to seventh or eighth dorsal vertebra, its superior angle may be found as high as the fourth cervical, and the inferior at second dorsal. The scapula is diminished in width and length, the latter to a greater degree, causing the bone to become long and narrow. The superior border is often bent forward, the superior angle hypertrophied. It is frequently connected by a bony growth projecting from the superior angle or from the upper third of the median border, to the transverse process of a cervical vertebra. The muscles of the scapula are frequently defective or weakened and contracted. The pectoralis major and minor and trapezius have been found wanting either wholly or in part.

2. *Bilateral.*

Fourteen cases have been described. The symptoms given above are usually found on both sides. The neck is very short and thick, the occiput coming near the seventh cervical spinous process, and the chin to the notch of the sternum. The cervical lordosis may be increased. Scoliosis is a more constant symptom than in unilateral elevation.

The general health is, as a rule, not affected, and deformities of ribs, vertebræ or other structures are common.

Etiology.

(*a*). *Age.*—The deformity is usually noticed at birth or immediately after. Slight stress can however be laid upon this point, as many do not present themselves for this deformity, which is often slight, but for some other cause, or when the deformity increases or the lateral curvature becomes noticeable. The following table is therefore of but passing interest:

Between the ages of 1–10,	72
Between the ages of 10–20,	41
Between the ages of 20–30,	9
Between the ages of 30–40,	3
Between the ages of 40–50,	1
Unrecorded	10
Total	136

(*b*) *Sex.*—This is equally divided, sixty-four males, sixty-three females, unrecorded nine. Sex, therefore, plays no important rôle in its causation. Girls, in whom the deformity is of greater consequence, will present themselves more frequently. We may, therefore, deduce that the percentage of males may be slightly higher than that of females. In congenital dislocation of the hip, on the contrary, the female sex predominates.

(*c*) *Side.*—Here we find a greater divergence. Right forty-nine (36 percent), left sixty-nine (50¾ percent), bilateral fourteen (10¼ percent), unrecorded four. The reason for its predilection for the left side is not easily explained. "The more frequent situation of the abnormity on the left side has been ascribed to the predominence of left occipito-anterior position, in which the left shoulder lies posteriorly." (Kölliker). Were position a factor, how is the bilateral elevation to be explained?

Of the sixty-four males, twenty-three, or 35.9 percent are right; thirty-six, or 56¼ percent left; females, twenty-five, or 39.7 percent right; twenty-seven, or 42.9 percent left; bilateral, male four, female nine, 28½ percent and 64⅛ percent, respectively. The forty-nine right cases are distributed as follows: Male twenty-three, or 46.9 percent; female twenty-five, or 51 percent. The sixty-nine left: male thirty-six, or 52 percent; female twenty-seven, or 39 percent. In both sexes the left is more prone to elevation. The female sex predominates in the bilateral cases.

(*d*). *Heredity.*—As exhibited by our tabulation, heredity plays but a small part in this deformity. We have found the entire family to be nervous in twelve cases; father to have tic of face and neck, one case; one sister nervous, one brother kidney removed, one sister lame, one case; mother scoliotic, two cases;

sister has congenital dislocation of hip, two cases; mother congenital dislocation of hip, one case; sister of father and other members of his family had high shoulder (Sick), 1 case; a total of ten, or $7\frac{1}{2}$ percent. Hoedlmoser and others believe that a nervous element exists in this deformity, in which theory they are strengthened by four cases of this list. The case of Sick, where several members of one family had congenital elevation of the scapula, is of interest.

(*e*) *Injuries During Pregnancy.*—Kirmisson reports one case where the mother had a fall in the fourth month; Jouon, a fall in the sixth month; Lamm, where the mother was compelled to do heavy work during pregnancy. The data on this point are very meagre and little reliance can be placed upon them.

Theories.

1. Sprengel ascribed this deformity to pressure, exerted *in utero* by lack of amniotic fluid, forcing and holding the arm backward. In two of his cases the child was born with the arm in this position and was later inclined to maintain it so. In a third this position was maintained during sleep. Perman, Kirmisson (case III), and Rager (case II) reported similar findings. In case I of Rager the opposite was true; the arm was inwardly rotated, with inability to rotate outward and to place upon the back. Sprengel found that by rotating the arm, placing the posterior surface of the forearm upon the back, and the dorsum of the hand upon the iliac crest of the opposite side, the elevated scapula could be simulated. It is, according to him, analogous to congenital dislocations elsewhere, also caused by a lack of amniotic fluid.

Intrauterine pressure may tend to hold the scapula in its original high position. In those cases (102 in number) where no articulation existed, it may be considered a factor. The deformities found in $67\frac{1}{2}$ percent of all cases may likewise depend upon intrauterine pressure. This pressure may cause (a) an arrest of development, deficient ribs and vertebræ, absence of radius, etc.; (b) dislocations of femur, radius, etc., due in all probability to a capsule primarily relaxed. Dr. Bradford bases his opinion upon a specimen in the Warren Museum of the Harvard Medical

School in which a dislocation of one hip-joint exists, and a very lax capsule without dislocation on the other side. (c) Retention of an organ in its fetal position, talipes equino-varus, talipes valgus, high scapula; (d) retention of an organ in its fetal form, altered scapula, cleft palate, etc.

2. Kirmisson believes that the malformation of the scapula, part of a general maldevelopment, is the cause of its elevation.

The maldevelopment of the scapula is, as we have shown, coexistent with its failure of descent, and is not its cause. Where an articulation exists it is likewise of parallel origin but can act as a mechanical hinderance. The curved superior border we believe to be of secondary origin, and not a factor. A prolongation of the superior angle can likewise not be accepted as a cause.

3. Schlange thinks that the high asymmetrical scapula and the contraction of the trapezius are parallel and caused by a congenital arrest of development due to amniotic adhesions. Von Winkel is also of the opinion that all deformities are due to amniotic bands and adhesions.

Amniotic bands cause deformity by traction upon point of attachment. A scar is to be expected at this site. This is not found or at least not mentioned in any of our cases. We can therefore discard this theory.

4. Exostoses and muscle contractions, the cause of elevation, are considered by Eulenberg to be due to a periostitis.

5. Failure of descent. Rager, basing his opinion upon the work of Chievitz of Copenhagen, believes the high scapula to be a retention in its fetal position, not a secondary upward displacement. He believes that through certain disturbances, abnormalities in the position of the scapula or alterations due to disease, a change in the shape of the superior border takes place which appears as an exostosis in the supraclavicular space. This elongated superior border, bending over the superior border of the thorax, hinders the descent of the scapula.

6. Goldthwait, Monnier *et al.* believe this condition to be analogous to congenital torticollis. Were the elevation a secondary retraction, this could be accepted, but we now regard the elevation as a failure of descent. Goldthwait is likewise of the

opinion that an injury at the time of birth may be the cause of the trouble, which condition has been demonstrated in torticollis. The alterations of the scapula are already seen at birth, and this injury if it existed, has had no influence upon the bone. Kayser thinks the contractions of the sterno-mastoid to be the cause, Lameris the defective rhomboid, Schlessinger the pectorals.

7. Kausch advanced the theory that the elevation is due to defect of the trapezius muscle. In three of his cases the defect was unilateral and of the lower portion, in two bilateral, entirely wanting in one. In one the rhomboid was entirely defective on the same side as the trapezius. The lower third of the trapezius, according to him, maintains the scapula in its normal position and its defect allows the bone to rise and move away from the vertebral column. "The degree of elevation will depend upon the extent of this defect, the age, and the development of the antagonists and synergists." Were this muscle closely examined, he thinks its defect would be noted in all cases. Graetzer does not believe that the muscle defect is, in spite of its frequency, the cause of elevation, because of evidence of arrested development in the scapula.

The maldevelopment of the scapula may be due to uneven muscle tension and the result of the changed function of the arm. Joachimsthal's case IV presented a rudimentary upper extremity on the same side as the elevated scapula which caused him to remark: "It gave the impression as if the normal weight of the arm were necessary in order to preserve the scapula in its proper relation to the thorax."

The earlier theory of Sprengel, that it is a secondary dislocation upward, must now be discarded, and that of Rager, that it is a failure of descent, adopted.

Descent of the scapula can be hindered in different ways. If we accept the view that the deformity of the scapula is primary, due to an arrest of development, and that this arrest is in the majority of cases not limited to this bone, but participated in by the muscles and other adjacent structures (ribs and vertebræ), as seen in our five and in several of the reported cases, we observe

that its retention (*i. e.*, that of the scapula) in the cervical region can be purely mechanical. This can be due to the hooked-like shape of the superior margin noticed in many cases; to the proximity of the superior median angle to the cervical vertebræ causing an irritation and consequent exostosis and bony union; to a cervical rib becoming attached to the scapula before its descent; to the coexistent weakness of the trapezius with its inability to draw the scapula caudally (where no union exists); and to the extension of bony growth within the sheet of development, according to the opinion of Dr. Minot given below.

We must acknowledge two different conditions to be present, the elevation and the malformation. This will lead us to formulate the following questions:

1. Are the changes in the scapula due to a primary arrest of development operating synchronously with the failure of descent or are they secondary, due to that position?

2. Is the failure of descent due to the changes in the scapula?

3. Is the failure of descent due to a contracted and weakened musculature?

4. Upon what does the defective musculature depend?

5. What relation do the frequent bony or cartilaginous articulations of the scapula with the vertebral column bear to its failure of descent?

All the variations of the affected scapula coincide with the conditions present in the bone during embryonic and early extrauterine life and adult life of lower mammals. The transverse position of the scapula is that of the quadrupeds. Whether the scapula remains in its embryonic position as a cervical appendage, or descends to its normal position, development, unless hindered by other causes, can go on. The scapula at a given period is in a given condition, and through mechanical causes further development ceases. It is not a reversion, but an arrest of further development. The scapula at this stage has the shape of a lower form, as all our structures undergo the mutations of all lower forms. These changes cannot, as claimed by Rager, be due to rickets after the descent is hindered by fixation. Hall in this connection states, that "In this process (cell generation)

the individual in a general way repeats the history of its species, passing slowly from the protozoan to the metazoan stage, so that we have all traversed in our own bodies ameboid, helminthoid, piscian, amphibian, antropoid, ethnoid, and we know not how many intercalary stages of ascent." Again, "The early stages of growth are telescoped into each other almost indistinguishably, so that phylogenetically the embryo lives a thousand years in a day, and the higher the species the more rapid relatively is the transit through the lower stages."

Descent and development proceed upon parallel lines. Descent depends upon the muscles which act in the dual capacity of bringing the scapula caudally and of shaping it to the adult human type. Where these muscles are defective, both these processes are retarded, the scapula remaining high and embryonic in form. The muscle defect is part of a general arrest of development in which the ribs and vertebræ participate (when present). The scapular changes are not part of that same phenomenon, but are dependent upon the muscular changes.

In $33\frac{1}{3}$ percent of all reported cases muscle defect existed. Cannot this be regarded as primary? Atrophy may result secondarily from diminished use of the arm. Such diminished use will, however, not cause a complete absence of part of the trapezius. The cause for this muscular defect is problematical. Bloch, quoted by Rager, thinks it to be intrauterine poliomyelitis; Nové-Josserand, a stigma. A nervous element must exist; probably an imperfect development of the spinal accessory nerve. Hoedlmoser's case, a male child, presented a floating kidney, from which the author deduces a nervous origin for both this condition and the high scapula. Gourdan thinks that a nervous element was added in his fifth case where atrophy of the entire upper limb existed. The histological examinations of Schlessinger in defective pectorals showed no changes, that of Lameris a fibrous degeneration. Schlessinger attributes imperfect development to a defective growth energy, "Wachsthumsenergie," not to an arrest from external causes. I am of the opinion that some mechanical force is responsible for the lack of development of the muscles.

The failure of descent of the scapula can be analogous to the failure of the descent of the testis. In the testis, however, there is no change or arrest of development in the structure of the organ as the latter is fully developed before its descent. In the scapula, on the other hand, we know that the changes in shape go on even after descent. It is a natural deduction, presupposing that descent and development proceed upon parallel lines, that arrest of descent checks further development, and that the scapula remains stationary at that point.

The causes for undescended testis we are ignorant of, but we do know that it is not dependent upon traction of the cremaster muscle as formerly supposed, as this muscle descends parallel with it.

The changes in the scapula cannot be considered as the cause of elevation. The curving of the superior border and hooked superior angle are secondary alterations which in no wise hinder the descent. The theory of Kausch is to be regarded as the best means of solving the question. This theory is likewise operative in those cases of mechanical obstruction by articulation. The muscle is not equal to the task of drawing the scapula down and by the same traction to shape the bone. The articulation is a primary growth, the alterations in the scapula secondary. The malformations of the ribs are also due to mechanical causes in early fetal life. All deformities must be regarded as having a mechanical basis for their existence. We must not go back to the ovum for their source.

Ehrhardt maintains that the elevation is merely a symptom and can exist in various conditions. He believes that the articulation theory is the best. He gives three contributing causes for elevation.

1. Pressure (Sprengel).
2. Muscle defects (Kausch).
3. Bony or fibrous articulations (Hutchinson, etc.).

Our theory for the elevated scapula is:

1. *That it is a failure of descent caused by*

   (*a*) *Too great intrauterine pressure, due either to an increased or diminished amount of amniotic fluid.*

(*b*) *Abnormal articulations of the scapula with the vertebral column.*

(*c*) *A defective musculature, unable to draw the scapula caudally, where neither* (*a*) *nor* (*b*) *exists;*

(*d*) *A normal musculature, unable to draw the scapula caudally where either* (*a*) *or* (*b*) *exists.*

2. *That the changes in the shape and size of the scapula are an arrest of development due to improper or defective muscular tension.*

Classification.

Milo divided all cases into two groups.

(1) "Pure Sprengel," with disturbance of functions of both arms, shortening, primary contractions of the muscles; an intrauterine-pressure deformity.

(2) "Pseudo-Sprengel," without disturbance of functions of arms, no contractions; a real or apparent exostosis being the cause.

Rager divides into four groups.

(1) Rotation of entire scapula, exostoses, uniting with vertebræ. Slight scoliosis to either side.

(2) Enlargement of upper median angle; only slight scoliosis to the affected side.

(3) Multiple exostoses from atlas to median border of scapula.

(4) Mere elevation, no changes in form or position; scoliosis may or may not be present.

Based upon our theory we will make the following classification:

(1) *Simple elevation, no muscle defect or articulation.*

(2) *Elevation with bony, cartilaginous, or fibrous attachment.*

(3) *Elevation with muscle defect.*

Diagnosis.

The condition must be differentiated from acquired elevation caused by

(1) Rachitis (Kölliker, Gross).

(2) Osteomalacia (Rager).

(3) Badly united fractures at the scapula.

(4) Paralysis.
(5) Severe scoliosis.
(6) Cervical Pott's disease (in bilateral cases).
(7) Empyema.
(8) Muscle contractures.

Rachitis causes a softening and deformity of the bone with secondary displacement simulating the congenital variety. The history of the case, where the elevation antedates the signs of rickets, and the radiogram, which shows not only a deformed but an infantile scapula, will easily differentiate this as well as that following osteomalacia.

Badly united fractures of the scapula may permit the bone to project upward. Here also the history and radiogram are of value.

Paralyses, cerebral or spinal, may cause a high shoulder, either through muscular weakness or through a secondary scoliosis. Signs of paralysis must be looked for.

Severe scoliosis often causes an elevation of the shoulder and scapula. Here, however, the high shoulder is always found on the side of the convexity of the curve. In congenital elevation the high shoulder may be either on the side of the convexity or of the concavity. The history of priority, the shape of the scapula and the radiogram are here also of value in determining the condition. Where rib and vertebral defects are found it may be assumed that the scoliosis is of congenital origin and the scapula, if deformed or small, is a concomitant congenital deformity.

Muscle contractions, of nervous or traumatic origin, cause a retraction of the scapula. The history will render a diagnosis possible. Heinecke reports one case in which the inferior angle of the scapula slipped from beneath the latissimus dorsi. The entire scapula was displaced upward and rotated upon its frontal axis, simulating congenital elevation. It was easily replaced.

Double elevation simulates cervical Pott's disease. In the latter we get the usual symptoms of bone disease with rigidity of the spine. The child may assume a wry-neck position, or the head be thrown well back and to one side, or the chin drooping

forward on the chest where the hands frequently have to support it. Pain, rigidity and desire to support are absent in the congenital elevation. Limitation of motion of the arm is absent in cervical caries. Cranial asymmetry is absent here, as well as in all forms of acquired elevation. Bilateral elevation has been observed in congenital cases only.

Fused or absent cervical vertebræ or cervical ribs will cause a shortening and thickening of the neck with elevation of both shoulders. The radiogram will show the cervical rib, but the former condition is rather difficult to determine, as it is not easy to obtain a radiogram of the shortened neck. Palpation may show the condition present. In bilateral congenital elevation there is a difference in the height of the scapulæ, the left usually being higher. This and its rotation, if present, will assist in establishing diagnosis.

Elevation of the scapula may follow empyema. Bender reports a case following inflammation of the shoulder-joint with ankylosis, simulating a congenital elevation. In both these latter conditions the diagnosis is not difficult.

Treatment.

This depends upon the class to which the case in question can be assigned. Where no articulation exists, and the musculature is weak and contracted but not defective, gymnastics and stretching, as employed in the series of seven cases of Dr. Bradford, are of benefit. Of these seven (VIII–XIV), case ten showed almost perfect restoration of function after nine months treatment. The shoulders were even, the scapulæ almost even. Cases XI–XIV showed marked improvement in motion and position. Case nine, a patient of 20 years of age, showed very little improvement as we should expect at this age. Gymnastics are likewise being employed in cases one and two but with slight success owing to congenital scoliosis and rib defects.

Where muscle defects exist and the height of the shoulder is marked, operative interference is justified. Likewise in cases not improved by stretching and where the scapula is maintained in its high position by adhesions. This class of operative procedure

is illustrated by that performed upon case XV by Dr. Brackett and in the first case of Goldthwait and Painter. A similar operation was performed by Gibney, Bülow-Hansen, and Eulenberg with good results. All these cases should be followed by gymnastic treatment. Where the cosmetic disturbance is slight, surgical interference is not justified.

Where descent is prevented by attachment, either osseous or

FIG. 3.—CASE I.
(*Thorndike's Orthopedic Surgery.*)

fibrous, extirpation of the articulations is demanded. This was accomplished by Dr. Brackett in case V, with very good results observed two years after operation; by Dr. Lovett with improvement in case VI. Similar operations were performed with improvement by Goldthwait and Painter in their second case; Jedlicka, two cases; Jones, Wilson and Rugh, two cases; Koenig one case. Bourret found two bands, one from transverse process of cervical vertebra into the superior angle and another into the middle of the

median border. The scapula was brought down, but the author reports that it was not a success. Kausch likewise reports a failure in case III of his series. He cut the trapezius and rhomboid and resected the articulation with little improvement. Lameris extirpated the tense band running from the base at the lower angle to the fourth dorsal vertebræ. This was part of the degenerated rhomboid. The scapula was brought down.

FIG. 4.—CASE. I. Absent ribs produce the furrow below left nipple. Supernumerary nipple on left. (*Thorndike's Orthopædic Surgery.*)

Where no articulation existed, but the scapula was held firmly by the curved border or hooked superior angle, these were resected with good results by Kölliker, Eulenberg, Fröhlich, Pitsch and Monnier. The entire supraspinata with a narrow strip of thickened base was resected by Ehrhardt with no improvement. Tabulating these results we see that resection of the articulations, curved border or hooked superior angle is the modus operandi in all cases where such exist, gymnastics to be employed in others.

Prognosis.

Where structural changes, such as are seen in cases one, two and three of our series, exist, little can be expected from treatment, and the prognosis, as far as the deformity is concerned, is unfavor-

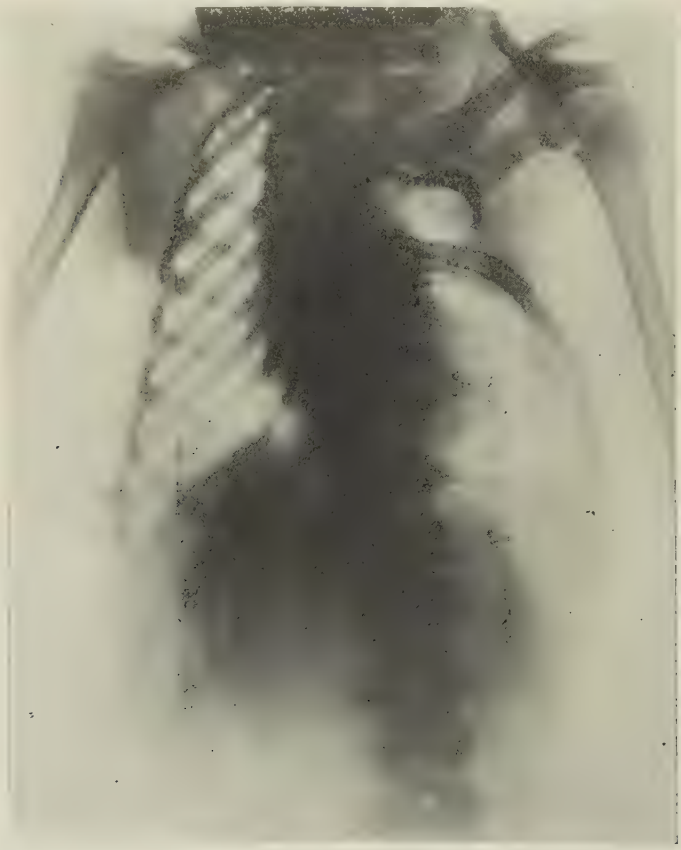

FIG. 5.—High scapula in concavity of lateral curve. Deficient and fused ribs. Wedge-shaped vertebræ. (*Thorndike's Orthopedic Surgery.*)

able. It need not, however, interfere with the enjoyment of life. A brace or jacket improves the position and to outward appearances the deformity is partially corrected. In operative cases a favorable prognosis may be given. In those requiring gymnastics, the prognosis, while guarded, may be favorable.

Report of Cases.*

Case I.—G. M., aged eight years. From the Boston Children's Hospital, Lateral Curvature Clinic.

Left scapula is three inches higher than right. The child was first brought to the hospital when five weeks old. Lateral curvature developed several years later.

Fig. 6.—Case II. From Lateral Curvature Clinic of Children's Hospital.

The points of interest in this case are the following: High shoulder in the first week of life; scoliosis away from the deformity (this appeared when the upright position was assumed, showing it to be congenital); shortening of the humerus; absence of the lower part of the trapezius; absence of ribs; supernumerary mam-

*The following case reports have been greatly condensed from the detailed accounts furnished by the author (Ed. Com.).

mary gland; torticollis; facial and cranial asymmetry; limitation of abduction, due to contact of inferior angle with the second dorsal vertebra; greater length of femur upon the affected side (measured from the greater trochanter to the patella). (Figs. 3, 4 and 5).

Case II.—I. S., aged eight years. From the Boston Children's Hospital, Lateral Curvature Clinic.

Fig. 7.—Case II. From Lateral Curvature Clinic of Children's Hospital.

Left scapula is two inches higher than right. The curvature and the high shoulder were noticed at the age of one, a "lump" on the back having been observed some time previously.

In addition to the high shoulder and the lateral curvature, this case presented the following: Slight facial asymmetry; high arched palate; slight strabismus; a half-inch shortening of the left humerus; absence and irregularity of ribs; wedged-shaped

vertebræ at the height of the greatest convexity; no bony articulation with the vertebræ. (Figs. 6, 7 and 8.)

Case III.—E. V., aged twelve years. From the Boston Children's Hospital, Lateral Curvature Clinic.

Right scapula is 5 cm. higher than left. The high scapula was noted at birth. A right dorso-lumbar curvature appeared at five.

There was no eye defect and no torticollis; the side of the face was flattened; the second and third ribs were absent on the right

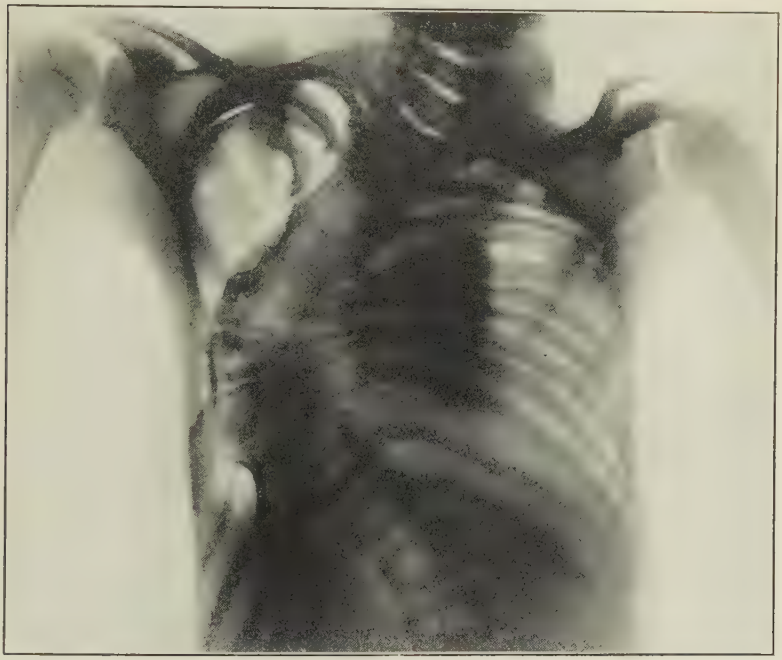

Fig. 8.—Case II. Radiagraph by Dr. A. W. George. High scapula on side of convexity of lateral curve. Deficient and fused ribs. Wedge-shaped vertebræ.

side and the fourth and fifth irregular in shape; the lower cervical and the first dorsal vertebræ were split and rudimentary, and the first and second dorsal were fused. (Figs. 9, 10 and 11.)

Case IV.—S. V., female, aged eleven years. Studied by the courtesy of Dr. Royal Whitman, Hospital for Ruptured and Crippled, New York.

Right scapula is two inches higher than left. The deformity was noticed at the age of two.

Two processes, one firm and bony and the other cartilaginous,

connect the superior border of the right scapula with the seventh cervical vertebra; a bony process extends from the left side of the seventh cervical but does not connect with the scapula. Other points of interest are; Facial asymmetry with atrophy of right side; slight torticollis to the right; right dorsal, left dorso-lumbar scoliosis of moderate degree; limitation of abduction.

CASE V.—B. S. By courtesy of Dr. E. G. Brackett.

FIG. 9.—CASE III. From Lateral Curvature Clinic of Children's Hospital.

Right scapula elevated on a level with the sixth cervical spine.

In this case operation was performed. A triangular prolongation from the upper portion of the inner scapular border was found, which extended about a half-inch from the scapula proper and ended in a small articular head, attached to the transverse process of the vertebra; in size, shape and appearance this prolongation resembled a rudimentary rib; the muscular attachments of the

scapula to the ribs allowed very little play and there was a strong fibrous band of fascia connecting the lower end of the scapula to the aponeurosis of the spinous process. The bony attachment in this case was the apparent cause of the high scapula; its removal permitted the descent of the bone with restoration of function, which was retained after the lapse of over a year. (Figs. 12, 13 and 14.)

FIG. 10.—CASE III. From Lateral Curvature Clinic of Children's Hospital.

CASE VI.—H. D., male, aged four years. From the Boston Children's Hospital. Right scapula elevated to level of fifth cervical vertebra. Displacement was noticed at age of two and ascribed to a fall.

Operation by Dr. Lovett. The trapezius was divided and the levator anguli scapulæ and two rhomboids peeled off from their insertion to the scapula; several tense bands of fibrous tissue, run-

ning to the upper border of the scapula, were isolated and divided; a process of bone, running from the upper posterior angle of the scapula upward into the neck, was divided; the scapula could

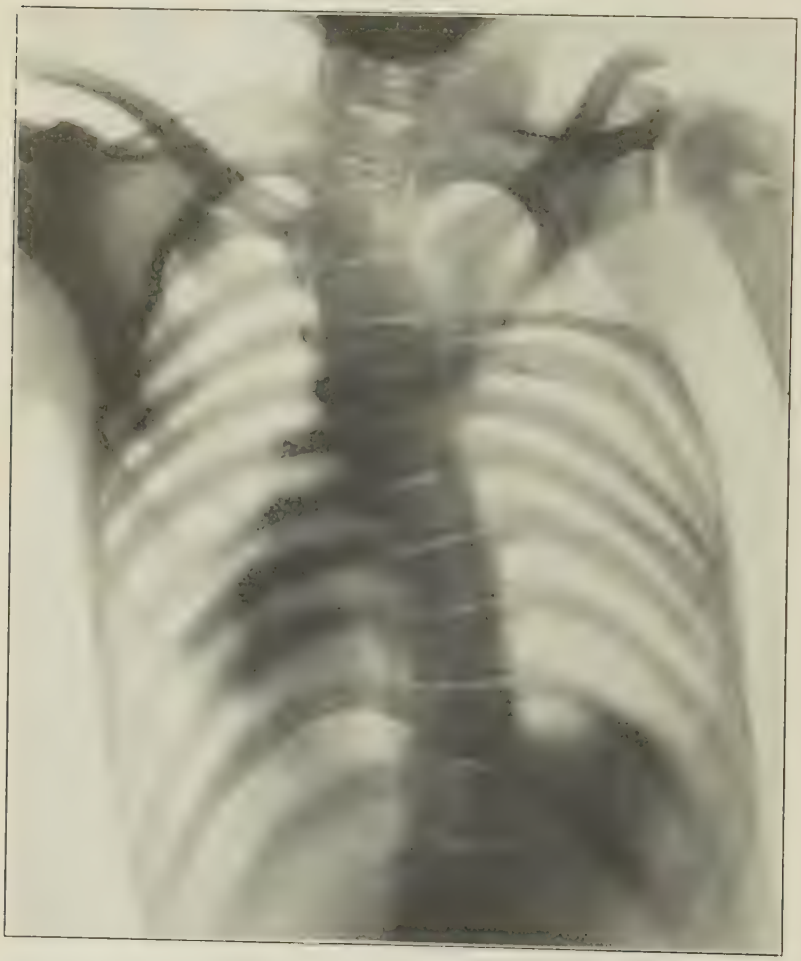

FIG. 11.—CASE III. Radiagraph by Dr A. W. George. High scapula on side of cavity of lateral curve. Deficient ribs.

now be pulled down into place. Patient was discharged relieved.

CASE VII.—F. W., female, aged three years. From the Boston Children's Hospital.

Left scapula is one inch higher than right.

The scapula is held firmly close to the spine; slight left postural curve of spine; deficiency of second rib from anterior axillary fold to costo-sternal junction; entire deficiency of pectoralis major, with partial deficiency of pectoralis minor, feet in valgus.

CASE VIII.—Baltic, female, aged eight. By courtesy of Dr. E. H. Bradford. Scapula is smaller, two inches higher, nearer the

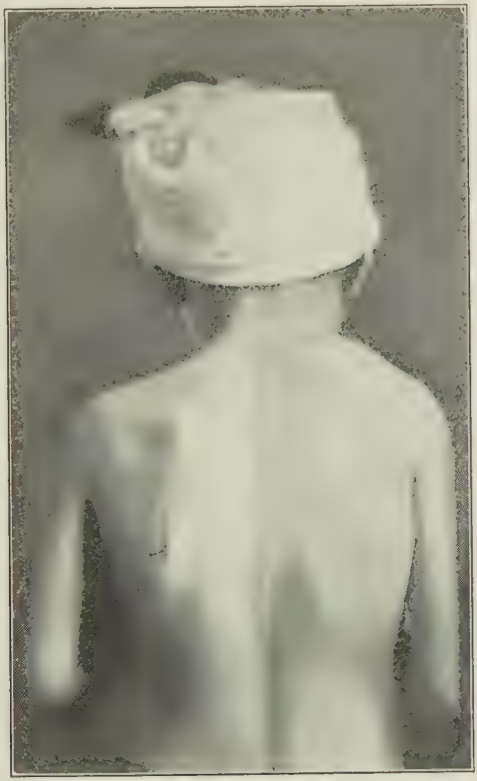

FIG. 12.—CASE V. Before operation. Private case of Dr. E. G. Brackett. No scoliosis.

median line, and less movable than its fellow; atrophy of deltoid and muscles over scapula; no bony deformity; slight shortening of arm.

CASE IX.—W., female, aged twenty years. By courtesy of Dr. E. H. Bradford. Left scapula one-half inch higher and smaller than right; no bony attachments but a small fibrous (?) attachment

restricting motion; arc of motion of scapula much restricted. Exercises or stretching gave very little improvement.

Case X.—Winchester, male, aged ten years. By courtesy of Dr. E. H. Bradford.

Left scapula slightly smaller and one inch higher than right; no bony or fibrous attachments; motions greatly limited. Through

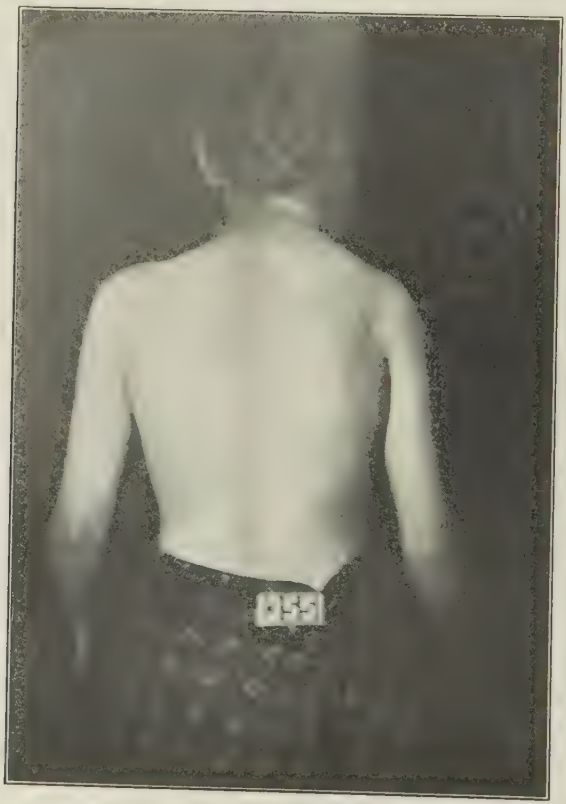

Fig. 13.—Case V. Two years after operation. Slight difference in height of shoulders.

nine months treatment by stretching and exercises the arm regained almost normal function; the shoulders were even, with little difference in the height of the scapulæ.

Case XI.—Newton, male, aged nine years. By courtesy of Dr. E. H. Bradford.

Scapula higher and nearer median line; no bony attachments;

cannot get hand or arm above shoulder. Good improvement in range of motion and in muscular development followed treatment.

Case XII.—Fiskdale, female, aged eight years. By courtesy of Dr. E. H. Bradford.

Scapula smaller in length and width and poorer in muscular development; arm shorter; elbow cannot be flexed beyond a right angle.

Case XIII.—Rockport, female, aged seventeen years. By courtesy of Dr. E. H. Bradford.

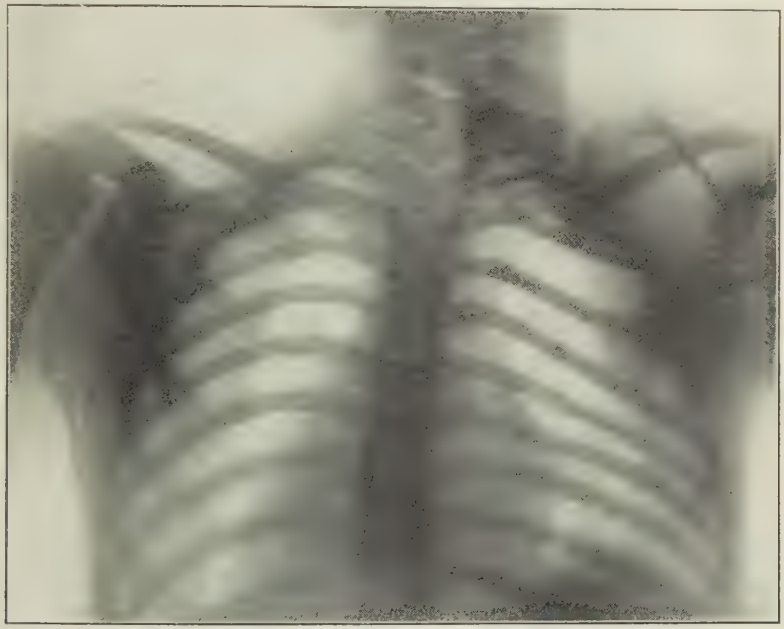

Fig. 14.—Case V. Showing bony union between right scapula and cervical vertebræ. No other skeletal deformities.

Left scapula smaller and one and a half inches higher than right; dorsal curve to left with a slight lumbar curve to right; no bony attachment; no difference in length of arms; muscular development poorer than on right. Much improvement in motion and position following treatment.

Case XIV.—Athol, male, aged twelve years. By courtesy of Dr. E. H. Bradford.

Right scapula two inches above left and shorter in length; it is held to the spinal column by fibrous or muscular bands; slight

right dorsal and very slight dorso-lumbar scoliosis. Improvement in range of motion after stretching and developmental exercises.

Of these seven cases, Nos. VIII–XIV, four were males and three females, four were on the right side and three were on the left, no bony attachment existed but there was a question of

FIG. 15.—CASE XV. Children's Hospital. Before operation. Right scapula higher.

fibrous union in two. In all, the vertebral border of the scapula was toward the median line, and the upper end further from the median line than the lower end as compared to the good scapula. The elevation of the scapula was from a half-inch to two inches. In five the scapula was smaller but without deformity; in one, however, the vertical diameter was shorter, which would give a greater scapular index. In three a scoliosis existed with the

convexity toward the affected scapula, one being a left postural and two dorsolumbar curves. Motion of the arm was restricted in all.

In this list there are several points of interest. The musculature was weak and undeveloped, but the scapulæ were slightly nearer the median line. According to Kausch this muscle defect would remove its inhibitory action and permit the scapula to go from

Fig. 16.—Case XV. Children's Hospital. After operation.

the median line. Exercises improved these defective muscles and restored a certain amount of function. Birth was normal in all cases.

Case XV.—G. F., aged seven years. From the Boston Children's Hospital.

Right scapula elevated about a half-inch above clavicular line; no tendinous bands or contractions palpable.

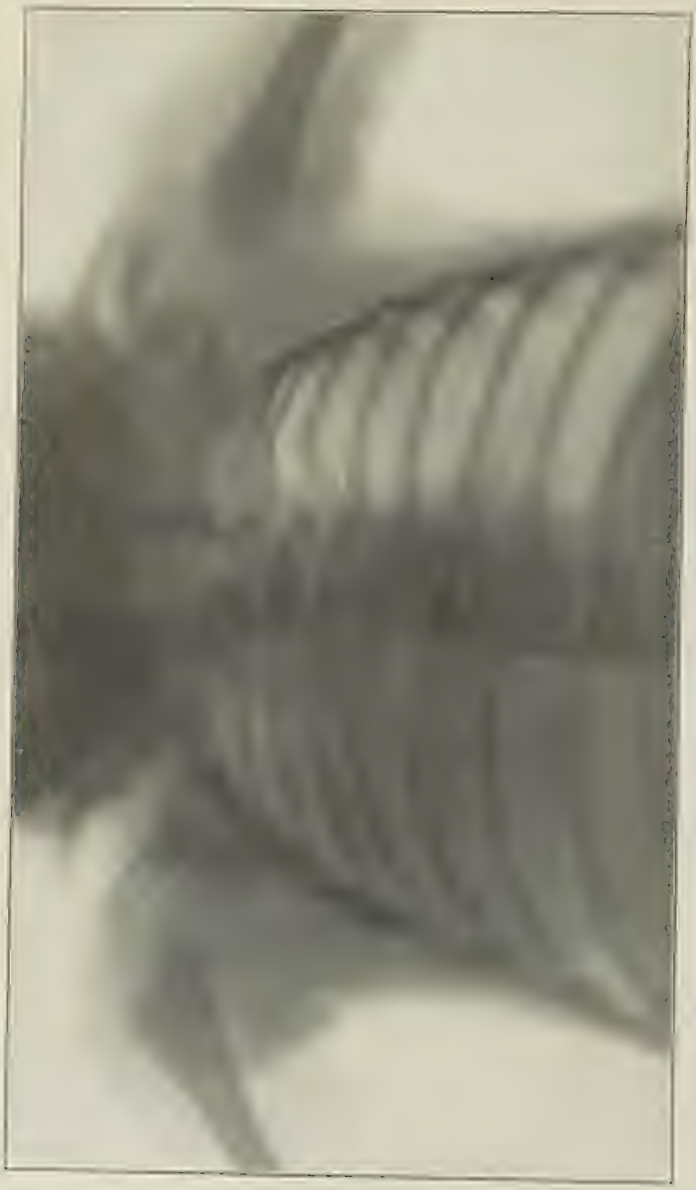

FIG. 17.—CASE XVI. Children's Hospital. Radiagraph by Dr. A. W. George. [illegible] region on side of concavity of lateral curve. [illegible]

Operation by Dr. E. G. Brackett. Portion of attachment of trapezius divided; fibrous and tendinous bands, extending from superior border and superior inner angle forward and outward toward the clavicle, divided; supraspinatus on vertebral border found extremely tense and cut; a tendinous band four inches wide and one inch long, attached along the lower third of the vertebral border of scapula and connected with four spinous processes, divided; scapula could then be readily brought down to about an inch and a half below its former position. (Figs. 15 and 16.)

Case XVI.—F. D., aged nine weeks. From Boston Children's Hospital.

Right scapula rudimentary, extending from occiput to second dorsal vertebra, and placed horizontally; left cervical scoliosis; second and third ribs on right fused at vertebral junction; deficiency of cervical vertebræ above seventh; inability to use arm.

Child died of "convulsions" at age of one year. Interesting features are the defect of the cervical vertebræ and inability to use arm with no evidence of obstetrical paralysis, which may have been due to an improper or deficient nerve-supply because of the vertebral defect (Fig. 17).

Conclusions.

1. The scapula in its development is a cervical, not a dorsal appendage. It retains that position throughout fœtal life. In its development the scapula, as well as the entire system, passes through the different stages of lower forms and repeats the history of its species.

2. In the scapula of congenital elevation alterations in shape are found, coinciding with the conditions normally seen in the scapula of lower mammals. These consist of an increase in width and a diminution in length, rounding of the superior median angle, and articulations with the vertebral column. Willet and Walsham claim these articulations (found in 25 percent of our collected cases) to be of suprascapular origin. Dr. Minot is of the opinion that they are due to centres of ossification appearing within the sheet of development of the scapula. This sheet is continuous with that of the vertebræ. If these articulations were of secondary growth due to attrition they would be bony throughout, whereas, the union at either or both ends is by means of cartilage.

3. The affected scapula is situated 1 to 12 cm. (two to four vertebral bodies) higher than its fellow, with an average of 3 to 5 cm., and rotated upon its frontal or sagittal axis. This rotation is due in part to the weight of the arm and in part to the retracted muscles.

4. Scoliosis existed in sixty-five cases (47.5 percent). This is usually of a mild character, excepting that seen in cases one, two and three of our series. It is cervical and high dorsal with a compensatory low dorsal or lumbar curve. The convexity of the curve is found toward the elevated scapula in 22½ percent, and away from it in 15½ percent. This curve must be regarded as of congenital origin, parallel with defective ribs and vertebræ, also with other evidences of arrested development elsewhere in the body, cleft palate, spina bifida, congenital dislocations, undeveloped limbs, etc., all due to the same mechanical pressure causes. The undeveloped scapula is not to be regarded as a deformity due to these same causes, but as of another type. The scoliosis is neither primary nor secondary to the elevated scapula.

Torticollis is seen in 10 percent and facial and cranial asymmetry without torticollis in 11½ percent. These deformities are therefore not dependent upon each other nor upon the elevated scapula.

5. Both sexes are equally prone to this deformity, sixty-four existing in males and sixty-three in females. It is more frequent on the left side, left sixty-nine, right forty-nine, bilateral 14. In the bilateral cases the left scapula is always higher. Kölliker believes this predilection for the left side to be due to the left occipito-anterior position of the fetus *in utero*, in which the left shoulder lies posteriorly.

Sixty-seven percent (ninety-two cases) showed some attendant defect in other parts of the body. Among these are seen missing and defective ribs and vertebræ, dislocations, defective limbs, etc. Heredity plays no part in this deformity.

6. Sprengel regarded this deformity as an upward displacement due to pressure exerted *in utero* through lack of amniotic fluid. We believe that pressure is a factor and that this retains the scapula in its original high position.

Rager believes that through certain disturbances, alterations in the shape of the superior border takes place which prevent the descent of the scapula.

Kausch advocates the theory that the elevation is due to the defect of the trapezius muscle. This was seen in $33\frac{1}{3}$ percent of the cases in our tabulation. We believe that the caudal migration of the scapula depends upon muscular traction. This traction may be insufficient where the intrauterine pressure is excessive, where abnormal articulations exist, or where the musculature is *per se* defective.

7. The maldevelopment of the scapula is due to improper muscular tension. The scapular muscles, by their traction, shape the bone to its normal adult contour. Where this muscular influence is lacking or diminished, or where the weight of the arm is lessened, either by maldevelopment or by abnormal position, or where the power of the normal muscle is unable to draw a scapula abnormally fixed, the bone remains undeveloped.

This muscular defect must precede the defect in the bone and is caused by some disturbance, nervous or mechanical.

8. Congenital elevation must be differentiated from the acquired form due to rickets, osteomalacia, paralysis, scoliosis, empyema and cervical Pott's disease. The history, symptoms and radiogram will be sufficient to establish the diagnosis.

9. Treatment consists of operative procedure or gymnastics. The results in operative cases, where an articulation existed, were good. A degree of improvement is offered by stretching and gymnastics.

In closing I wish to thank Dr. E. H. Bradford for his timely advice, Dr. E. C. Brackett, who has kindly permitted me to make use of his private records, Dr. R. W. Lovett for his valuable criticism, Drs. J. B. Blake and Z. B. Adams for their friendly advice and suggestions and Dr. Chas. S. Minot for laboratory material, suggestions and opinions.

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EDITORIAL.

In complying with the request of the Editorial Committee that I should write a leader on infantile paralysis, I enter upon the task feeling greatly honored but with considerable diffidence. The subject is so vast and it literally bristles with unsettled problems. During recent years, both in America and Europe, very earnest and successful work has been done which has encouraged us all to greater enterprise and effort in a branch of work where encouragement has been sadly needed. The recent experiences in New York State and Massachusetts have driven home to the profession generally the knowledge of the infective nature of poliomyelitis, so we venture to hope that in due time our laboratory work may beneficially modify the course of the disease. The epidemics described by Medin, Cordier, Brackett, Taylor, Caverly, and others added to personal experiences, convinced most of us years ago of its infective character, while the occurrence of the disease after scarlet fever, measles and summer diarrhea, pointed suggestively to a toxic origin. This branch of the subject is one which requires very patient investigation and study by pathologists.

The retrogression of the paralysis is a very remarkable phenomenon occurring as it does sometimes so rapidly and at other times so late. It is this fact which supplies us with patience and hope even in what appear to be the most hopeless cases. It proves to us that only a few cells are usually destroyed and that the rest are but damaged by temporary pressure or by organic change. A very interesting communication bearing upon the pathology of poliomyelitis was that of Goldscheider. He based his conclusions on the examination of three cases which pointed to the fact that the lesion was closely connected with the distribution of the central

branches of the anterior spinal artery. His investigations led him to the conclusion that the lesion in poliomyelitis was not confined, as we were wont to argue, to the vertebral horns, but that it invaded the white matter and the dorsal horns. This was the area governed by the central branches of the artery. The branches usually travel in the long axis of the cord, so that if we take the cord at any level we find it supplied by branches from several central arteries. Goldscheider discovered that when one such artery escaped attack the cells in the area it governed also escaped. For this reason various groups of cells were affected at different levels. Goldscheider thought these changes due to the entrance of some irritant into the vessel walls, leading to their greater dilatation and to a proliferation of their endothelial elements; from this as a centre the neuroglia became affected and the changes in the ganglion cells and nerve-fibres he considered as secondary—a kind of necrosis taking place due to impaired nutrition. This suggestive investigation, if the conclusions be correct, simplifies the clinical aspect of a case. The sudden onset of inflammation leads to pressure and disordered nutrition of the ganglion cells over a large area and their function is in abeyance. With the return of a free circulation some of the cells return to normal function, while in others the vascular storm has been so severe as to permanently destroy them. Recent demonstrations prove beyond doubt that a ganglion cell may undergo great changes in structure without losing its capacity for repair. Death so rarely occurs in connection with the acute phase of poliomyelitis that post-mortem investigations are rare, so whenever an opportunity comes it should not be missed. Physiological and pathological experiments should be directed to throw more light upon the changes noted in the affected cells. Comparisons should be made between these and changes in the same region associated with old cases of amputation, cerebral palsy and ankylosis of the older joints. Already Warrington has added to our knowledge by division of nerve-roots and by careful comparison of motor cells at various periods after removing the limbs of growing animals.

Of more direct interest to the surgeon is the clinical aspect of

the question, more especially as to progress and treatment, with the knowledge of the almost complete recovery of cases of total paralysis—at times varying from days to months—accurate prediction is obviously impossible and the despair of the neurologist should only be a stimulus to the surgeon. Up to a few years ago in England—and this is probably true of America—the physician was a hopeless pessimist when he dealt with the paralysis of children, and even now only a few realize the surgical possibilities. It should be understood that from the moment of its onset the surgeon as much as the physician should be consulted and the plan of future campaign fully discussed. If this occurred not one single instance of fixed deformity would be met with.

We know from extended experience that muscles for years looked upon as paralyzed, will resume their contractility if appropriately treated. We know that in rarer instances muscles which exhibit the reaction of degeneration may recover. We must impress upon all concerned that it is only by the intelligent recognition of the differences between the disabilities due to mechanical causes and those due to central pathological changes that satisfactory progress in treatment can be made. Most helpful in the solution of this problem is Thomas' theory enunciated upward of a quarter of a century ago, namely, that an overstretched muscle while the strain is continued loses its function. For a muscle to contract well it must have a certain elastic tension and a normal tonicity. We have convinced ourselves by experiment that strong healthy muscles if overstretched by posture temporarily lose their contractile power; how much easier for a partially paralyzed group, overpowered by opponents to lose for years—until release from tension comes—any active power.

Preventive treatment is based on our knowledge of the course of the disease, more especially as regards deformity. The paralyzed groups from the first should be kept relaxed. In the vast majority of cases the extensor groups require our care, and for months should be kept without even once being subjected to strain. The want of continuity in treatment is answerable for many failures. The useless and overstretched biceps and brachialis anticus may recover their power if the elbow be acutely slung

for some months continuously, whereas, if it be extended even once a week, failure might result. In the case of children much too young for tendon transplantation or arthrodesis, in order to keep the paralyzed groups of muscles continuously relaxed, a very simple operation may be performed.

We all know that when we apply splints, parents of all classes temporarily remove them on various pretexts, and among the poor folk, children are often even allowed to take off their splints and walk.

For this reason it is well to adopt accessory measures where we dread any strain upon the paralyzed tendon, and a very effective plan is to excise an oval flap of skin from the paralyzed side so planned that when the edges are united the deformity is well corrected. This operation, simple and safe, which injures neither joint nor tendon is the only one applicable in the case of very small children and we have found it very helpful. The question of keeping paralyzed groups in prolonged relaxation is in our opinion so fundamentally important that we venture to draw your attention to three cases which have been already published. They practically demonstrate two facts, that if a muscle be stretched for sufficiently long it will cease to act and furthermore that it will again regain its power if relieved from strain.

A girl, aged 13, who had been afflicted for years presented a complete paralysis of the shoulder and upper arm but had free use in the hand (the upper-arm type of Erb). There was no power of extension or flexion at the elbow, and the electric reactions denoted complete paralysis of biceps and brachialis anticus. As is our custom in such cases, we moved a large diamond-shaped flap from the upper and lower arm, and attached the forearm to the arm, so that the elbow was fixed at an acute angle, the patient was thus enabled to use her hand for many useful purposes about her neck and face. Many months afterward our colleague Mr. Armour on examining her, found the skin slightly stretched, but noted that the girl could flex her forearm several degrees. In fact, restoration of function had taken place in the paralyzed brachialis anticus and biceps, structural shortening having taken place in the bodies of the muscles. A second case, three years

paralyzed, and similarly treated and tested, resulted after four months in complete muscular restoration. Now we would draw your attention particularly to a third case, similar in most respects to the other two, where the paralysis had lasted seven years, but during the whole of this time a flicker of contractility had been noted in the biceps, so slight as to have no effect upon the forearm, which lay limp and extended. We slung the forearm in a position of acute flexion, and sealed it in such a way that for some months its position could not be changed. Some power was soon manifested in both the biceps and brachialis anticus, and by degrees the arm was lowered to the position of right angles. It was then found that from that position the arm could voluntarily be acutely flexed with moderate power. The patient's doctor at this stage, thinking the arm was well, took the sling off. The sequel was most instructive; the weight of the forearm so stretched the recovering muscles that the arm again lay limp, extended and powerless, and function was regained only when flexion has been continued for a sufficient length of time. The bearing of these cases on the question of tendon transplantation is obvious.

The most severe critics of the various operations of tendon transplantation have admitted the occasional success. They say at first the muscle acts but later on it fails. The student of orthopedics knows that if a transplanted tendon begins to do good work, it should continue doing so. If relapse takes place, it shows that the efforts of the weak muscle in the discharge of its new duties have not been sufficiently assisted. Instead of being carefully nursed, it has been subjected to overstrain either by the action of opponent groups, or by erroneously applied body-weight. Having operated upon nearly three hundred cases, many of them proving failures, we are convinced that tendon transplantation although it has a distinctly limited application will retain a permanent place in surgical procedure. The best result certainly is not a perfect substitute to normal action, but in the knee and ankle, excellent effects may be secured by the surgeon if he will realize that his functions do not end when his operation is completed. We ascribe most of our early failures to inadequate preliminary over-correction of the deformity we wished to

correct, to incorrect tension and fixation of the reinforcing muscle or to over deflection of the transplanted tendon. To prevent this we should divide opposing muscles, shorten paralyzed ones and exsect skin-flaps. When the tendon is fixed to periosteum or bone it should be tightly sewn, but it should not be pulled so forcibly that it will not slacken slightly by over-correction of the foot, for, as we know, an overstretched tendon is in danger of rapid atrophy. So much depends on intelligent personal supervision that one is not astonished at the more encouraging results we obtain in private than in our hospital work.

Our early results in arthrodesis were not so good as we would have liked and this was due mainly to the mistake of operating upon very young children. We have not known a case of bony union occurring in a child operated upon under four, but in children over ten the fixations very rarely fail. The deformity at the ankle which occurred in early cases—usually a pure varus—due to irregularity of growth only follow operations in the very young. When arthrodesis is performed at the ankle for equinovarus, both the deformities of inversion and extension should be fully corrected by wrenching before fixation is undertaken otherwise an increasing adduction of the foot will occur with growth.

The ankle-joint is admirably suited for arthrodesis and Goldthwait's suggestion of oblique osteotomy of the fibula in order to simplify bony apposition is a decided improvement in the operative technic. Properly performed and in suitable cases the operation of arthrodesis is a very valuable aid to the surgeon and his patient and the failures which have been reported have been generally due to the neglect of fundamental principles.

We are not in a position yet to apportion the place of nerve anastomosis in the treatment of poliomyelitis. At best its applicability must be limited. In the upper extremity it is very rare to find a paralysis limited to a supply from one nerve-root or one spinal segment, with the exception perhaps of the fifth cervical. Generally it is spread over several spinal segments and then no nerve anastomosis will avail. In palsy of the deltoid however, and in the leg where the paralysis is confined to one group of muscles, nerve anastomosis may have a place, but we must never

forget how risky it is to divide a nerve-trunk, for even after scrupulously careful anastomosis additional paralysis may result in the muscles supplied by the already affected nerve. We must confess, however, to being much impressed by the experiments of Kilvingham, who has shown in a diverse set of conditions very successful results in animals.

When we look back only a few years to the hopeless state of paralyzed children, we are proud of the advances made by surgery. It is in our power, no matter what the age or condition, to correct deformity. With the spread of the knowledge we already possess to practitioners in general work, we can safely predict that paralytic distortion will cease to exist, and that the hopeless figures swinging on crutches will only be known as a parental reproach.

Robert Jones, Liverpool.

DISCUSSION OF PAPERS PUBLISHED IN THIS NUMBER AND READ AT THE CHICAGO MEETING OF THE AMERICAN ORTHOPEDIC ASSOCIATION, JUNE, 1908.

Discussion of the papers by Drs. Bradford, Lovett* and Townsend,† published in this number.

Dr. McKenzie said that there had been two or three epidemics of the disease in Canada, to the most marked of which the attention of the members of the Association might have been drawn, as statements regarding it had frequently appeared in the daily papers. It occurred in the autumn of 1905 or 1906, in the valley of the Ottawa River, where the towns of Pembroke, Renfrew and others are situated. These are places of from three to six thousand inhabitants. The valley is an excellent agricultural district. This epidemic was the most severe that has ever occurred in Canada, although Dr. McKenzie did not know just how many cases there were. In the city of Ottawa there were but few cases, although it is not far away from these towns and is in the same valley. This city has sixty thousand inhabitants.

Many that had seen the cases considered them to be cerebrospinal meningitis, but Dr. McKenzie has learned from conversation with many of these men that they have since somewhat changed their opinion. Some of the patients consulted the late Dr. James Stuart, of Montreal, who would be considered as good an authority as anyone and he considered them to be cases of anterior poliomyelitis. The consultant at Toronto, who was called down to see the cases, also had no hesitation in stating that they were anterior poliomyelitis.

The speaker saw none of them in the early stage or during the acute illness, but he saw quite a number of them afterward. He stated that the conditions in those that he had seen were similar to those ordinarily following infantile paralysis. There were a number of deaths—a larger percentage than that recorded by Dr. Lovett. There were several instances in which three cases occurred in the same family. Dr. McKenzie knew of at least two families having three children that have been left badly disabled from the effects of the illness.

Touching the matter of treatment, he said that, omitting all reference to the

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† Vol. vi.—No. 1. *Journal American Orthopedic Association.*

mechanical treatment, he lays great stress upon the plans recommended by Dr. Townsend, when he has an opportunity to apply means to prevent the deformity in the early stages.

The speaker laid a great deal of emphasis upon the word education, which had not been used in any of the papers read. In order to illustrate his meaning, he gave some details of the cases, particularly of the case of the most debilitated and disabled individual that he had ever seen as the result of this disease. The patient was a boy of fourteen years, seen by Dr. McKenzie five or six years ago. Two years and a half before this, the boy had suffered with an attack of infantile paralysis Three months before the onset of this attack, he had had a severe attack of diphtheria. Whether the latter had any relation to the subsequent attack of anterior poliomyelitis Dr. McKenzie did not know. The attack was very severe and the muscles of respiration were largely involved. The patient was entirely helpless. He recovered from this illness but two years and a half later Dr. McKenzie found him sitting in a chair and having to be supported on all sides, although an intelligent, well-developed lad. If not supported, he would fall over, owing to the large amount of affection of the body muscles. Each leg was absolutely incapable of movement. The left arm was good. The right shoulder group was badly affected, but the muscles below the elbow on the right side had a moderate degree of power.

When asked by the family to do something for the lad, Dr. McKenzie declined to do so, on the ground that it would be impossible for the boy to handle crutches. He said, however, that if the lad should acquire sufficient power to do this, he would attempt to help him.

Four years afterward the boy was brought to the doctor, having recovered sufficient power in the muscles to be able to handle crutches. He had extensive tilting of the pelvis, extensive lateral curvature and complete disability of both legs and of the gluteal muscles; but a good left arm and power in the right arm below the elbow.

The speaker uses a trolley running across the gymnasium fifteen feet from the floor, with a car on it. A rope also crossed the gymnasium, by which the boy could pull himself along. He would so use his body, by the aid of the rope, as to throw one leg ahead of the other in imitation of walking. This process was continued for a number of weeks, and then braces were applied, with a spring lock at the knee. He still continued the exercise. Subsequently he gave up the ropes and used crutches to drive him forward. After this, weeks and months having elapsed, the straps supporting the head were gradually relaxed and finally removed. He can now go along on a level surface, though he still has absolutely no power in either lower extremity.

This paralysis extends largely into the body muscles. The tilting of the pelvis and the body has been somewhat corrected, but still exists. He can rise from a sitting posture by means of a device enabling him to use his arms,

allow his brace to lock, take his crutches and walk from place to place. Muscular power has not developed to any extent. The muscles that were affected are affected in much the same way now; and there has been but little gain in that way, but he has become educated during this time so that he can use his power to greater advantage. Without this great stress upon education, it would have been impossible for him to gain the facility of movement which he now evinces.

Dr. Ridlon thought that there should be put on record a fact that had not been mentioned so far, that anterior poliomyelitis is not confined to children. He had seen during the last four years several cases in adults. One patient was a woman of sixty-two years at the time of the onset of the disease. Another was a girl of seventeen, of a neurotic family. Dr. Ridlon thought, on first examining this patient, that her condition was hysterical; but later he had to abandon this diagnosis, and an eminent neurologist confirmed that of anterior poliomyelitis. The woman of sixty-two was seen by a physician and also by an eminent neurologist before Dr. Ridlon saw her. In view of the fact that the disease is not confined to infants and young children, Dr. Ridlon said that care must be taken not to overlook its symptoms when they appear in adults.

Dr. Sherman said that the present epidemics of anterior poliomyelitis and the exceeding care that is being taken in the study of them and in the treatment of the patients may give an opportunity to obtain an answer to the question as to the real value of electricity in such cases. This had been a mooted point with him for a long time, and he had gotten into trouble with his brother physicians a number of times by forbidding the use of electricity in these children. This annoyed men who had been expecting to give a long course of treatment with electricity to the patients. He wanted to know more about the subject, so as to correct his opinion, should it prove to be faulty.

He had asked Dr. M. Allan Starr about fifteen years ago what benefit could be expected from electricity in such cases, and Dr. Starr said none. Dr. Sherman did not know whether Dr. Starr had changed his opinion since then.

Dr. Sherman had always looked upon electricity as merely a means of irritating the child, just as sticking a pin into him. He never uses it in making an examination to discover which muscles are paralyzed, unless the child is old enough to tolerate the faradic current or it is impossible for him to differentiate between the muscles without the use of electricity. He has always succeeded in getting a fair idea, either by tickling the child or by pricking its foot with the end of a wooden toothpick enough to make it try to move to get away from the annoyance. This develops which muscles it can move and which it cannot.

Dr. Sherman does not see how faradism to a paralyzed muscle can affect the condition of the spinal cord. If the cord gets well, the muscle will

follow. The paralysis of the muscle is only a symptom of the lesion of the cord. If any electricity ought to be used, Dr. Sherman would be inclined to select galvanism to the cord, to stimulate nutritive processes and lessen the number of nerve cells in the anterior cornu which are affected or hasten their recovery.

He said that Dr. Starr had once reported a case of diphtheritic paralysis in which galvanism was applied to one arm, and it was noticed that the recovery of this arm was much more rapid than that of the other. Galvanism was then applied to the other arm, leaving the first one alone; and the second arm was found to then excel in the rate of its recovery the arm first treated. This Dr. Starr stated to be the only instance in which he had received any testimony to show that galvanism can stimulate a nutritive process. If it is of benefit, Dr. Sherman wanted to know how it works.

Another thing that should be done, he said, is to make pediatrists add another procedure to their systematic examination of patients. No physician now thinks of seeing a sick child without looking into its throat, and children who are in bed with a little febricula should always have their throats examined. At the same time, the soles of the feet should be tickled to see whether they can move both legs. By doing this the pediatrist will often save himself the mortification of having a paralysis discovered by the mother in his absence and not by himself, and will make a much better impression upon the family.

Dr. Peckham said that he was much in sympathy with Dr. Townsend's plea for the orthopedic treatment of these infantile cases. A neurologist is apt to use electricity until the deformity stares him in the face, and then turn the case over to the orthopedist for surgical procedures, when these could often have been rendered totally unnecessary.

Dr. Peckham was also interested in Dr. Sherman's position regarding electricity. When the speaker first began to practice, electricity and massage were both used, and it seemed to him that the good results obtained were always due to the massage, and not to the electricity. He has practically abolished the use of the latter entirely and is getting better results in the way of muscle development than he did when he employed it.

The theory of the neurologist, said Dr. Peckham, is that the muscular contraction produced by the faradism to the muscle exercises the muscle so that its tone is retained until such time as other treatment can be applied. He himself, however, did not think that faradism does this. He said that if the claims made for the Morton wave currents should prove to be well founded, the use of this form of electricity might be advisable in such cases. If the surgeon, by throwing a Morton wave current through the spine, can produce a dissipation of congestion, good may be done by it. The seat of the trouble, rather than a symptom of it, will then be attacked.

Dr. H. L. Taylor remarked that the papers presented in the symposium had displayed the results of very careful preparation. What they had

contained had confirmed, on the whole, what had been generally accepted by orthopedic surgeons as the result of their experience.

Dr. Taylor then said he would like to say a word on the position of the neurologist, particularly upon the question of the use of electricity. He had many friends among the neurologists, and respected them very much. At the same time, he was compelled to state as the result of his observation regarding diagnosis, that a careful examination of the voluntary power by a competent orthopedic surgeon had usually proved more useful in prognosis and treatment than a report of the electrical examination by a neurologist.

He had found electrical treatment for anterior poliomyelitis to be absolutely harmful during the attack and for the first two months thereafter, and to be practically useless after that time. In that respect, he said, the neurologist and the general practitioner should be educated so that they will no longer advise patients to visit a physician's office once, twice or three times a week for months or years without receiving the slightest benefit; when at the end of that time, or at any previous time, proper orthopedic treatment would have put the child on its feet.

Mr. Little said that his experience in England had been the same as that of Dr. Sherman, that the commonest history that one gets in such cases is that the child went to bed well and woke up paralyzed. This is not always the history, however.

Dr. Townsend said that he would like to say a word regarding the paper of Dr. Lovett, so far as the cases of complete recovery were concerned. During the last year, in observing cases in the hospital, he had seen a large number that were accompanied at the onset with a great amount of weakness, possibly due to a toxemia. Apparently there was in these cases a good deal of shock connected with the onset of the disease. In one or two of these cases there were remarkable recoveries, and Dr. Townsend thought that it was in this class of cases that some of the so-called complete recoveries have been made. While he did not wish to be dogmatic, he felt that he must state that among the three hundred cases of anterior poliomyelitis examined during the past year he had not seen a single case of complete recovery. In cases in which the recovery had been pronounced complete it was possible to demonstrate that there was still a loss of power, although marked improvement had taken place.

Dr. Sherman asked how Dr. Townsend intended to conduct an educational campaign when he was starting with an error and perpetuating it?

Dr. Townsend, closing, said, in reply to Dr. Arnold, that his experience had been with children, and not with chickens.

Regarding electricity, his belief was that it is of very little value; faradism being employed merely as a placebo by most orthopedists. They do not believe it accomplishes anything, but use it merely because there seems to be a feeling among the profession at large and the laity that it should be em-

ployed. Galvanism is preferable but the orthopedist has found that electricity in any form is of doubtful value.

Replying to Dr. Sherman's question regarding what faradism is, Dr. Townsend said that he would reply, What is electricity?

Dr. Lovett, closing, said that he had merely given the figures in regard to recovery from paralysis for what they were worth and that he believed the cristicisms of them to be just. He had personally seen one case of recovery in a patient with extensive paralysis of the arm in which he had given a bad prognosis.

His reason for commencing this work was definitely educational. He believed his paper and that of Dr. Townsend to be more complementary to each other than they appeared to be. Until the general practioner has been gotten interested in these cases, the results will not be good; and by calling the attention of the profession of Massachusetts to this inquiry in that State, he had hoped that he might succeed in enabling them to recognize the cases more sharply. He attached more importance to this aspect of the paper than to any other.

As regards treatment, Dr. Lovett said that one conclusion that had not been mentioned was of interest. He thought that it would appear to any of the members that the most sensible treatment for a case during its onset would be to empty the bowels instead of blistering the spine. Dr. Theobald Smith, he stated, had reviewed all the literature of the subject carefully in regard to the question of etiology and had done a good deal of experimental work, and he had reached the conclusion that, so far as one can judge in advance, it looks as if the disease were an intestinal infection with an anaerobic bacillus such as might be gotten through milk. The investigation will go into the question of the milk supply of cases affected.

As to the epidemic and sporadic cases, Dr. Lovett said that one sees a good deal of this distinction. He could have reported several of these foci as epidemic, because they were larger than a good many epidemics that have been reported. On the other hand, he could have reported any case as sporadic. Therefore, he did not consider the distinction to be of much value.

Regarding the treatment, he thought that one word might be of use in getting the assistance of the neurologists, who sometimes hold their patient on electricity too long. The spinal motor cells are grouped longitudinally in the spine, showing bundles running the length of the cord. A group of motor cells will reach through two or three segments, each muscle receives impulses from more than one centre; and each center sends impulses to more than one muscle. Pathology shows plainly that the poison of anterior poliomyelitis comes through the blood. The lesions are around the blood-vessels, and are most extensive where the blood-supply is most extensive. The blood-supply is horizontal. Therefore, given a poison distributed through the circulation, the lesions being greatest where that poison is strongest, if you have a poison coming in horizontally to cut off a power associated longitudinally, unless the

lesion is extensive, some cells in a special centre are likely to escape. Dr Lovett thought that the matter of partial paralysis receives too little attention. It is not, he said, the fact that a muscle is paralyzed or not that is of the most importance, for it may be paralyzed either partly or completely or may be simply stretched and disused. In the treatment of deformity, therefore, orthopedists will not get where they should be until they recognize that between the stages of activity and paralysis there is a stage of weakness.

He was much gratified by the remark that a voluntary effort made by a contracting muscle is the most important stimulus to the muscle. He thought that more attention should be paid to voluntary attempts to move muscles, in addition to massage. He wished to emphasize the point that the most valuable therapeutic means is that when one begins to stimulate the muscle, one should attempt to get voluntary motor impulses to go through the cord and pick up any cells left in these partly destroyed spinal centres.

Discussion of Dr. A. S. Taylor's paper on the Surgery of the *Motor Peripheral* Nerves.

Dr. Ryerson said that he had done the operation of nerve transplantation or grafting, as described by Spitzy, in seven cases. Three of these have been frank failures, the operation having done no good whatever. One patient has been lost sight of. In the remaining three cases, the parents of the patients think that they have been much benefited; but they live too far away for him to have been able to make the electrical test. The first operation was done three years ago. Dr. Ryerson said that it was manifest that these children can walk better and that the feet are in better position; but whether this was not due to their long encasement in plaster of Paris in the correct position he was unable to state.

It seemed to him that Spitzy's method is not very rational; that is, the implantation of the diseased nerve into a slit in the healthy nerve; and Murphy, in a late article, has claimed that it is not advisable. On the other hand, Dr. Ryerson thought that Murphy's procedure is a very dangerous thing; because it is difficult, in these little children, to identify the fibres that it is necessary to conserve. If the posterior tibial nerve is healthy, one cannot tell, in splitting off a piece, whether one is taking a piece that innervates the gastrocnemius or the soleus. It is not safe, he said, to run the risk of destroying the usefulness of these muscles. He had not felt that in any case he was justified in taking away a healthy nerve, to attach to a diseased one.

It seemed to Dr. Ryerson that in the brachial plexus cases, instead of using the catgut, it would be better to use the dog's artery, which is a little more rational. A sterilized artery connecting two nerves by an underground tunnel is better than catgut. He does not feel at all satisfied with his technic, which has not given the results Spitzy has recorded.

Dr. Young said that he had not expected to speak upon this subject, but that it might be interesting for the members of the Association to know that he had united the two largest nerves in the body—the sciatic and the pop-

liteal—in a case of paralysis of the external popliteal, which was completely paralyzed. At the suggestion of Dr. William G. Spiller, of Philadelphia, he had united it with the internal popliteal. Sensation was lost for twenty-four hours, and then returned. Nutrition was considerably improved. The parents of the patient were pleased, but the result was not scientifically perfect. The child walked better than she has done, but the nutrition has not increased as Dr. Young had thought it would.

In another case, he had united the nerves supplying the anterior tibial muscle with the musculo-cutaneous. This was a success. The patient can now turn her foot inward and upward, and he was sure this result was due partly to the action of this muscle.

The other patient he has lost sight of, so he does not know whether the operation was successful or not.

In regard to the technic, he had found that by using fine instruments he could avoid injuring the nerve. He uses a cataract-knife and iridectomy scissors. He feels confident that if the nerve is sutured in place and the axis-cylinder properly placed in position, there will be no injury to either nerve. He had demonstrated this by uniting these nerves.

Dr. B. R. McKenzie asked the length of the gap closed over in this operation for brachial paralysis; the cut did not indicate it, and he had not heard the point discussed.

Dr. Sherman asked whether, after it had been taken out, the scar-tissue could not grow in again. He thought that this might be so, even if a dog's artery were used. Serum would fill the lumen of the artery, or it would fill with air; and there would be an opportunity for scar-tissue to grow again.

He also said that he had watched quite a number of children with birth-palsy, and had seen, as months and years passed, a return of a considerable amount of power—an amount quite equal to that illustrated by Dr. Taylor in the photographs of boys exhibited; and he asked how one could tell, in a little child, whether power would return or not. He thought it would be wiser to wait for its return rather than to expose the child to the danger of operation with the added trauma. The children whom he had seen had improved to such an extent that no surgeon would now think of attempting operative intervention in their cases.

Dr. Stern said that some years ago Drs. Frazier and Spiller, of Philadelphia, had reported a nerve operation for the purpose of curing athetoid motion of the upper extremities in a young man of twenty. They operated on the left side first, mixing the brachial plexus by crossing the musculo-spiral and circumflex nerves; and achieved such success that they operated on the right side later.

This case had encouraged Dr. Stern to perform an operation for athetoid motion of the right arm. Later on he had asked Dr. Frazier about the result in his case; and, while the latter did not say that it was a failure, he did not claim that it was much of a success.

In Dr. Stern's case the athetoid motion began in the extensors of the hand and after the spasm was well under way would affect the flexors. He therefore cut everything in the brachial plexus excepting the median nerve and had implanted the cut ends into the unsevered median, hoping thereby to supply the muscles with non-athetoid impulses; he also crossed the musculo-spiral and the circumflex nerves after the plan suggested by Drs. Spiller and Frazier. The immediate result was a complete motor and sensory paralysis of the entire arm. Soon the athetoid motion of the shoulder-girdle increased in severity and athetoid movements reappeared in groups of muscles supplied by the nerves, which Dr. Stern was ready to swear to, he had divided. In many instances these movements were severer than before the operation. After a time these secondary athetoid movements lessened and finally disappeared.

Three years have now elapsed since the operation, sensation has returned to the arm and the athetoid motion has been almost entirely abolished, only returning now and then when the patient makes an unusually severe muscular effort with his arms; but Dr. Stern felt sorry to have to acknowledge that there is as yet no voluntary motion present in the arm or hand except in the adductors of the thumb. He imagined that his result was just about as good or as bad as that in the case reported by Dr. Frazier. At any rate he had succeeded in stopping the athetoid motion, a task which in itself is not always of the easiest.

Dr. Ridlon said that Dr. Charles E. Thomson, of Scranton, Pa., was present. As he had had some experience in this line of work, Dr. Ridlon made a motion that he be invited to discuss the subject. This was done.

Dr. Thomson said that he was very much pleased to have heard Dr. Taylor's paper. He had had five cases of nerve surgery. The first of these operations was for injury of the external popliteal nerve, and was performed eighteen months after the accident. Dr. Thomson made an end-to-end anastomosis. He uses catgut throughout his work. In this case, true to his old orthopedic instinct, he put the leg in plaster of Paris in marked flexion, and kept it there for a long time. He had to employ this position, in order to get the nerve-ends together, there being a space of about two inches between them. The results, while slow, have been very good. No improvement took place for about a year, when the patient gradually commenced to get the use of his limb. It is now ten years since the operation was done, and he has now obtained perfect function.

The injury in this case was an incised wound, completely severing the external popliteal. It was due to a boy's having thrown a piece of slate at the patient.

The second case was a fracture of the head of the tibia, in which the nerve was destroyed or sloughed away in the sepsis following the compound fracture. The operation was done a year and a half after the accident, and a good result was obtained.

The third case was one of musculospiral injury. The arm was fractured and the nerve divided. The patient had complete paralysis, and the result in this case was not so brilliant. At least, Dr. Thomson met with the mishap referred to by Dr. Taylor. Within a year, fairly good function was secured, but six months later, the paralysis commenced to return. The condition went on to complete paralysis. Dr. Thomson operated on it for the second time, and found the nerve imbedded in a mass of fibrous tissue and very much diminished in size. He freed the nerve, put some muscular fibres about it, an closed the wound; and he has succeeded in obtaining a very good result.

The fourth case was a most unfortunate one of injury to the sciatic nerve in a mine accident, in which the young man lost one leg. The other thigh was fractured above its middle. The surgeon who amputated the other leg, put this one up in plaster of Paris and treated the fracture, but did not notice that it was paralyzed until several months later, when there was complete paralysis of the muscles supplied by the sciatic nerve. A great deal of trouble was experienced in finding the ends of the nerve, because the fracture was away from the joint. After this operation the patient had scarcely any movement for two years; but since then he has improved and gone on very satisfactorily.

The fifth case, said Dr. Thomson, scarcely belongs to this category. He apologized for reporting it, but said that Dr. Perry Clark, a friend of Dr. Taylor, had been very anxious that it should go on record. It was a case of laminectomy, in which the spinal cord was completely crushed. After having learned the hopelessness of any relief, and working under the suggestion of Dr. Clark, the injury being in the mid-dorsal region, Dr. Thomson freed the two nerves on each side and traced them out along the ribs. He then drew them in, passed them down, and united them to the nerves below the injury, as they came off the cord. Unfortunately, the man died of some abdominal trouble, about ten days after the acident, the abdominal trouble having been incident to his previous injury. For this reason, nothing about the result of the operation could be known, further than that the possibility of such work in cases of injury to the spinal cord had been demonstrated.

Dr. Samuel C. Baldwin, of Salt Lake City, said that he wished to say a word regarding a matter that Dr. Thomson had touched upon; that is, that lack of success in these cases may be due to cicatricial constriction of the nerve. He had recently operated for the second time on a case due to a fracture sustained some years ago. At the first operation, the ends of the nerve were united; but the patient subsequently had paralysis and wrist-drop, and was unable to raise the fingers. Dr. Baldwin operated again, and found that the condition was due to scar-tissue and a neuroma the size of a pea. This was removed, the nerve closed over the point, and the scar-tissue dissected off; and in a short time the patient was able to extend the fingers perfectly.

Dr. A. S. Taylor, closing, said that before one can decide whether a lateral implantation has any disadvantages, some systematic experimental

work must have been done to show the relative value of this procedure and the end-to-end method. We do not yet know how the the connection of the implanted nerve to the sound trunk occurs. Such work has not yet been done, but Dr. Taylor hoped that good results might be obtained from it in the future Meanwhile, he thought that the lateral implantation seemed to be the better method; as it does the minimum amount of harm to the patient, and a good return of power is obtained.

Regarding the facial nerve many operators thought that it should be divided transversely, and an end-to-end anastomosis done; but he said that in none of the cases reported with photographs had the results been any better than those in the boy in whom a simple lateral implantation was performed. Opinions in regard to the matter, he considered to be based more upon theory than upon actual practice.

As to the use of arteries for bridging, he thought it was all very well theoretically; but he did not see how one could have a sufficient supply of arteries on hand prepared to meet varying indications. Besides this, he said that it was desirable to put no foreign material into the wound that could be avoided. On the whole, he thought that the records were best when the work had been done by means of the simplest method—suturing of some form. Whatever is put in acts as a bridge along which the nerve-fibres regenerate. The simplest thing that will give good results is the best. The difficulty with gelatin-preparations, etc., is that you do not have a supply with you, and that they are not so adaptable as what you already have. The thing wrapped around the sutures is cargile membrane, which prevents an undue growth of tissue within the nerve-ends.

In regard to Dr. Young's statement, Dr. Taylor said that although the parents have been more or less pleased with the result, there is no physical evidence of improvement from the standpoint of the physician examining the patient.

Dr. McKenzie had asked about the distance between the nerve-ends. Dr. Taylor said that in this case the gap was two centimetres—almost an inch.

As to Dr. Sherman's question regarding the growth of connective tissue, Dr. Taylor said that one has to expect a certain amount in every case. He thought it was a question whether the nerves grow more rapidly than the cicatricial tissue returns. Except in the simplest end-to-end sutures, the fact that good results are not obtained is due to an ingrowth of connective tissue.

Respecting the spontaneous return of power, it had been Dr. Taylor's experience that, beginning in two or three months, there is a spontaneous improvement, which goes on for about two years and then ceases, with definite and everlasting paralysis, according to the amount of injury done to the plexus.

He said, however, that one cannot argue much from one case, or half a

dozen cases; there must be a great number, before sound principles can be evolved that will guide one in deciding whether to operate in any given case.

Discussion of Dr. Packard's paper on Typhoid Spine.

Dr. Porter said that he had seen quite a number of cases of typhoid spine in his service at the hospital. One patient came back to the institution for treatment of the spine within two or three weeks or a month after discharge. He had found that patients that had left the hospital and come back usually say that they have had pain in the spine since shortly after getting up and around, and that they have kept on getting worse. All these patients were treated by putting them back to bed.

In some cases, as Dr. Packard had said, the patients have referred pain; but most patients have none. In those in which the pain was marked and the symptoms severe, he had thought of the X-ray picture shown by Dr. Baer, of Baltimore, the preceding year. He had some very useful pictures of typhoid spine, which showed a pathological process in the vertebræ. Dr. Porter believed that the severity is in proportion to the amount of inflammatory reaction that takes place. He had had to use plaster of Paris in only one case, and did not remember any that had not recovered completely under the sole treatment of keeping the patient flat on his back.

Dr. Rugh said that he had had two cases of this kind, one of which was very much of the character described by Dr. Packard. The symptoms came on rather early after the attack of typhoid, and were relieved by complete fixation with a plaster jacket in three months' time. The other case was one of severe injury following the delirium of typhoid, the patient having jumped out of a window. There was a marked kyphosis of the lumbar spine, which followed within between six months and a year after the injury; but it was entirely relieved by proper support. The progress of the typhoid spine was so much more rapid than the similar tubercular condition of the spine that Dr. Rugh believed the diagnosis of typical typhoid spine with destruction of the bodies of the vertebræ to have been clearly made out.

REPORTS OF SOCIETIES.

The International Congress on Tuberculosis met in Washington, D. C., September 21, 1908, and continued through the 12th of October. The first and last weeks of the meeting were devoted wholly to the exhibition. The second week, beside the exhibition, was occupied with section meetings.

The exhibition and section meetings were all held in the new building now being erected for the National Museum. The arrangements were necessarily somewhat crude, as workmen were still engaged upon the construction of the building. This fact was a defect, however, to the section meetings only.

The exhibition touched upon every phase of the tuberculosis problem, and included a model dairy after the plan of Mr. Strauss; relief maps and models of sanatoria in all parts of the world, notably some in the German exhibit; graphic comparisons of the mortality of tuberculosis and various epidemics of disease, e.g., yellow fever and cholera; models of "shacks," tents and outfits of all kinds for the public and private management of tuberculosis, as well as demonstrations, charts and other graphic representations of the various social and economic relations of the disease.

Very many of the foreign countries were represented by official government exhibits, and from our own country there were elaborate displays from many of the States and from the national government in its various services, e.g., the Army and Navy, the Department of the Interior, the Department of Commerce and Labor and the Department of Agriculture. A number of the larger cities in the country had separate exhibits illustrative of the methods of regulation and control which are being employed in attacking the various problems of tuberculous disease in the cities' crowded tenements. The Bureau of Animal Industry and some of the medical schools sent many specimens illustrative of the pathology of tuberculosis. The gross lesions in animals were particularly well displayed in the Animal Industry exhibit. Abundant opportunity for the demonstration of all matters demonstrable by means of the X-ray or stereopticon were provided.

The exhibits were very accessible, well arranged and in some instances demonstrators were in attendance to give periodic explanations. The entire exhibit was conspicuously free from any suggestion of commercialism. No one seemed to be advertising anything, and though there was abundant literature to be had, it was all of an educational character.

In the second week the sections met, and there were two and three sessions a day. The work of the Congress in this respect was divided into seven divisions, viz.:

I. Pathology and Bacteriology.
II. Clinical Study, Therapy, etc.
III. Surgery and Orthopedics.
IV. Tuberculosis in Children, etc.
V. Hygienic, Social, Industrial, Economic Aspects.
VI. State and Municipal Control.
VII. Tuberculosis in Animals and its Relations to Man.

Besides these sections, to which there were 459 papers presented on the official programme, there were two general sessions for the entire Congress and twelve special lectures, six delivered in Washington, three in Philadelphia and one each in Baltimore, New York and Boston. These were all on general subjects concerning the tuberculosis crusade, and were delivered by distinguished foreign representatives visiting the Congress. A large number of prizes were offered in many lines in order to stimulate interest in contending with this disease. Up to the second day of the second week, 6100 had registered, but that did not indicate that there were that many accredited delegates present at the Congress. There seemed to be a good deal of popular interest and the exhibition was well attended. Section meetings were not so well attended, though differing but little in this respect from any large gathering where the discussions are carried on in sections.

Abstracts of a majority of the papers presented to the Congress were distributed to those who registered at the meeting, and were published in French, English, German and Spanish. The officers of the Congress are to issue the original papers and discussions in a four-volume series about three months after the close of the Congress.

The following are the authors' abstracts of a few of the papers which seemed likely to be of most interest to orthopedic surgeons, chiefly those read in the Section on Surgery and Orthopedy.

The Histogenesis of Tuberculosis of Bones. By Dr. Josef Kertesz, of Budapest.

CONCLUSIONS.

The author has made a number of experimental examinations in the pathological institute of the Herr Hofrath Prof. Dr. Otto Pertik to clear up the question of the initial stage of tuberculosis of bone marrow, with the following results:

The tubercle bacilli introduced into the bone marrow of rabbits are very quickly surrounded by polymorphous leukocytes, and they as well as a portion of the fixed connective-tissue cells situated in the district invaded are destroyed within 2 or 3 days. Another portion of the fixed connective-tissue cells as well as the desquamated endothelial cells of the capillaries increase amitotically.

These cells as well as the young proliferated elements group themselves about the tubercle bacilli and form the epithelioidal tubercle, which is completely formed as early as the fourth day.

The first tuberculous giant cells appeared to the view of the author on the fifth day, originating at this stage through a confluence of the augmented endothelium of the capillaries.

On the seventh day lymphocytes group themselves about the tubercle, which latter at this time already shows signs of caseation in its centre.

On the eighth day the lymphocytes penetrate the tubercle; thus originates the lymphoid tubercle.

The leukocytes do not reach the neighborhood of the bacilli in their initial accumulation from the blood-vessels, but rather from the septa of the neighboring bone marrow.

The lumina of the capillaries in the neighborhood of the tuberculous tissue are obliterated either through pressure or they disappear through the desquamation of the endothelium which then begins to proliferate.

The giant cells are formed, according to the author, in a number of different ways.

The accumulation about, and the migration into the tubercle on the seventh, and eighth day takes place also from the neighboring bone marrow. The connective-tissue elements of this tissue proliferate.

It is very probable that this increase in connective tissue produces the obliteration in the blood spaces.

The destruction of the tubercle, its coagulation necrosis, is caused, therefore, not considering the toxins of the bacilli, by the obliteration of the capillaries and the blood spaces in its neighborhood.

Two Special Forms of Tuberculous Arthropathy of the Knee. By Dr. Mauclaire, Fellow of the Faculty of Medicine of Paris.

I have seen here two anatomical varieties. In the first there is an effusion containing rice bodies, in the second a gelatinous effusion.

(*A*) Arthritis with rice bodies was observed in a young woman twenty-nine years old, of very strong constitution, with no trace of pulmonary tuberculosis. The illness began in January, 1907, and I examined the patient three months later. She showed all the signs of a hydrarthrosis, but with pressure the characteristic crepitation was elicited. I performed external arthrotomy, followed by evacuation of the effusion and antiseptic cleansing. The patient recovered rapidly and wore a knee cap. She resumed a very active profession, which obliges her to walk a greal deal. I see her every three months, and to-day, fifteen months after the operation, there is no local recurrence nor trace of tuberculosis in any other part of the body.

It is true that similar cases are not rare. The interesting points about my case are the absence of unpleasant postoperative effects and the permanence of the cure, most cases of arthritis with rice bodies showing a tendency to fungous synovitis. The case is, therefore, one of attenuated tuberculous arthritis.

(*B*) Arthritis with gelatinous effusion of the knee was observed in a young woman thirty-two years old. The symptoms were those of a typical white swelling. After making the incision for a resection, I was surprised to find in the joint a rather abundant gelatinous effusion. The articular surfaces themselves were but little injured. There were some fungous changes in the joint and a tuberculous osteitis of the patella.

I did a resection of the knee. Union was delayed and the limb had to be immobilized for four months.

This gelatinous aspect of tuberculous effusions is very unusual. Nevertheless, I observed it in a case of tuberculous peritonitis in a young girl. In the left iliac region and hypochondrium there was a gelatinous mass, and in the rest of the abdomen tuberculous granulations scattered over the entire peritoneum.

According to some writers, tuberculosis of the prearticular serous bursæ presents this gelatinous aspect and many cysts of the popliteal space are regarded as tuberculous.

The Problem of Immunity in Tuberculosis. By Dr. Edward R. Baldwin, M. D., Saranac Lake, N. Y.

A retrospect is given of what has been accomplished in attempts to produce artificial immunity, with mention of the problems yet unsolved. A brief review traces the beginning of preventive inoculation experiments almost from the time of the discovery of the bacillus by Koch. These naturally began in France, stimulated by the brilliant success of Pasteur in the use of attenuated bacteria. This principle is still foremost in

present-day experiments. It is not generally known that Americans were among the earliest to achieve a degree of success, especially Trudeau and de Schweinitz (1892–94).

The results on the whole were discouraging, and attention was directed to attempts at antitoxic immunity during the period of this important discovery and the first tuberculin era.

The soluble extractives of tubercle bacilli having failed to immunize animals, Koch introduced the emulsions or new tuberculins, T. R. and B. E., which were partially successful.

The discovery of differences in virulence between typical human and bovine types of bacilli by Theobald Smith gave an impetus to investigations of protective inoculations in cattle; while the study of various pseudo-tubercle bacilli and those modified by passage through reptilians renewed the hope for a successful method for the production of artificial immunity. Simultaneous experiments on bovine protection by means of human bacilli were made in several countries, all resulting in a marked degree of resistance to inoculation, but von Behring first announced a "Bovovaccine" claimed to be efficacious when used by two successive intravenous inoculations. Koch and Schutz followed with a more virulent preparation called "Tauruman." To overcome the objections due to the use of living human bacilli and to apply the principle of immunization to human beings was the next obvious step. Hope of this achievement was held out by von Behring at the last Congress at Paris in 1905. Nothing definite has been made public since then to indicate that this hope was justified or that the immunizing and therapeutic properties of the so-called "Tulase" were superior to the bacillary preparation T. R. of Koch introduced a decade ago.

Meanwhile other investigators have worked with encouraging success on cattle by spacing the inoculations at shorter or longer intervals (Pearson and Gilliland) by feeding the vaccine (Calmette and Guerin) with bacilli in capsules (Heymanns), and with those made nonvirulent or modified by passage through other species of animals (Klimmer). This is the trend of research to-day for bovine immunization. The situation now is not hopeful for the establishment of a long-continued immunity by any method either in cattle or man. The specific resistance of cattle after one or two inoculations of human bacilli wanes and fails entirely after six months to two years. Furthermore, living human bacilli may be retained in the tissues or excreted in the milk of protected cows many months after inoculation (Schroeder and Cotton; Weber and Titze).

Subcutaneous injections have been claimed to give equally as strong protection to cattle as the intravenous method, but the danger of local abscess formation must be overcome. The subtle difference between the immunizing value of living and dead bacilli needs investigation. Thus far no method has appeared equal in value to the inoculation of living bacilli. Repeated protective treatment must be considered necessary from the present outlook and by means of an agent equally innocuous to cattle and mankind. Protection from tuberculous infection must also be issued during a period of time needed for developing the specific resistance after the first treatment, at least in young subjects.

It appears desirable also that all avenues of infection should be subjected to local immunization, as, for example, by feeding and inhalation of the protective agent. The finer mechanism of immunity requires close study to adjust the dosage and intervals. Some way of measuring immunity is needed. A correct balance must be attained between the specific response

to infection which occurs during the hypersensitive phase of immunity and the ability of the tissues to assimilate the poisons without suffering harm. An immunity which tends only to arrest the infection, but not to overcome it, is not wholly beneficial when it creates ulceration at the portal of entrance. Hence the question whether hypersensitiveness artificially induced by protective inoculations is beneficient or otherwise must be considered. It is conceivable that an immunity without tuberculin susceptibility may be defective; on the other hand, complete tolerance to tuberculin may be associated with a high resistance to infection in cattle. The problem thus seems to be to create tolerance for the bacillus poisons or its products when undergoing lysis and their assimilation by the tissues.

Without the unknown quality called "tolerance," no real immunity can exist; and the earlier in life this can be established with absolute safety, the more resistant the adult must become.

The studies of Bartel on the influences of lymphatic cells on the tubercle bacillus as well as those of Opie on the leukocytes promise to enlarge our knowledge of this subject.

Yet more light may come from investigations now in progress on the mechanism of anaphylaxis and its prevention.

Finally, the problem of passive immunity is still a distant goal which should not be forgotten. On this rests the hope of an efficient therapy.

Contribution to the Question of Percutaneous Infection. By Dr. Isidora Spitzstein, Budapest.

We know that Prof. Krehl, Heidelberg, discussing the furuncles produced by Garre through percutaneous application of staphylococci and the positive percutaneous infection experiments with guinea-pigs of the Austrian Pest Committee in his Patho-physiology (1906), explains these successful infections through the apparently intact skin by considering it probable, that the inunctions produced slight injuries of the surface of the body and of the epithelium of the skin glands. Prof. Cornet also emphasizes in his book (Die Tuberculose, 1907) that the successful issue of the cutaneous infection experiments (sputum, etc., was rubbed into the skin of the cheeks, nose, etc.), depended entirely upon whether superficial injuries of greater or less extent preceded the infection.

The experiments of C. Fraenkel (The activity of tubercle bacilli through the intact skin, Hygienishe Rundschau, 1907) again called our attention to the question, inasmuch as this investigator succeeded in producing general tuberculosis in guinea-pigs by treating them through the intact skin percutaneously.

I performed my series of experiments with this mode of infection in the laboratory of the Königin Louise Sanatorium; I employed a type of animal less susceptible for tuberculosis, the rabbit.

In this preliminary communication I can report only concerning the result with 9 rabbits.

The skin of the abdomen of these 9 rabbits was first carefully shaven; 48 to 72 hours afterward portions of a well-tested, virulent pure culture of the human tubercle bacillus were rubbed into this area with the greatest care; the procedure was carried out with such gentleness that even the slightest traumatic injuries of the skin and of the walls of the canals going into its depth (the hair follicles, sebaceous gland ducts) were avoided. One of the animals died after 2½ months, but without development of tuberculosis. The other 8 animals continued to live; 4 were killed after 3 months and 4 after 4 months. Neither local nor regional changes could be demonstrated

in any of them. Nor could tuberculosis be demonstrated in any of the internal organs. Neither did the kidneys nor lungs, which in rabbits are predisposed to the disease to an extent, show any changes.

My experiments, which are not by any means finished, lead to the following conclusion thus far: If percutaneous infection is at all possible it certainly is the most unfavorable mode of infection for the tubercle bacillus; in the case of the rabbit particularly so, as it is decidedly refractory to the disease.

On the Conjunctival Reaction of Tuberculine. By Dr. V. Malmstrom, Stockholm.

The conjunctival reaction has been experimented by me on 252 patients. In most cases it has been carried out in the following manner, which I have considered as the most suitable: 1 drop of a ½ percent solution of Alttuberculine has been instilled into one eye of the patient, and if no reacting followed, the experiment has been repeated with a solution of the same strength on the other eye at least 4 days after the first instillation. Stronger solutions do not seem to be quite harmless for the patient. Repeated instillations into the *same* eye are of no diagnostical use (Levy, Deutsche med. Wochenschrift, No. 3, '08, etc.). In more than half of the cases in which, in spite of existent tuberculosis, no reacting appears at the first experiment, such a reaction can be provoked by a new instillation of the same solution into the *other* eye of the patient. By absence of tuberculosis, a positive reaction is, on the contrary, with such a proceeding very rare, which is proved by the following figures. The phenomenon depends according to Sig. Cohn on a *general* hypersensitivity ("Ueberempfindlichkeit") with the tuberculous persons caused by the first instillation.

Out of the established tuberculous cases 69 percent gave a positive reaction at the first experiment, 17 percent only at the second one: Sum 86 percent.

Out of the suspicious cases 37 percent gave a positive reaction at the first experiment, 10 percent only at the second one: Sum 47 percent.

Out of the cases clinically exempt of tuberculosis, 10 percent gave a positive reaction at the first experiment, 4 percent only at the second one: Sum 14 percent.

In some cases the reacting brought about fever. Out of the 25 cases, where a postmortem examination has taken place, 20 (9 tuberculous, 11 not tuberculous) confirmed the result gained by the conjunctival experiment. In 5 cases, which had not reacted, tuberculous alterations were found. A patient suffering from diabetes mellitus reacted positively at the second experiment, but did not show any clinical signs of tuberculosis. At the postmortem examination tuberculous alterations were found in the glands of the mesenterium of the small intestine, otherwise no tuberculosis.

On 11 patients a subcutaneous as well as a conjunctival experiment with tuberculine have been made. Complete concordance in 8 cases, difference in 3.

From the above experiments the conclusion may be drawn that the conjunctival reaction, though of the greatest value as a diagnostical expedient, gives no verdict, neither in a positive nor in a negative direction.

Hereditary Disposition as a Factor in the Etiology of Tuberculosis. By Dr. Johann von Szabóky, Budapest, Gleichenberg.

The author announces the following results of statistics which he collected from 1456 tuberculous and from 1433 nontuberculous cases:

1. The danger of infection should be recognized and every prophylactic measure hailed with joy, but the danger of infection should not be overestimated nor should the oft-recurring phthisiophobia be magnified by excessive precautions.

2. The importance of hereditary as well as acquired disposition must be recognized, for although hereditary disposition is not too frequent, it is, nevertheless, according to the author, quite as frequent as acquired disposition.

3. The greatest rate of percentage was shown by those with an inherited taint, about one-half on the father's and one-half on the mother's side. In only one-third of the cases tuberculosis showed itself in the parents before the birth of their children. A smaller percentage showed tuberculosis in the grandparents and in the smallest percentage of the cases tuberculosis in brothers or sisters was noted.

4. The phthisical habit cannot be designated as a characteristic of tuberculosis nor of hereditary disposition, although it occurs chiefly in hereditary cases, less often in acquired ones and almost never in nontuberculous individuals.

5. Hereditary disposition exerted no influence upon the gravity of the cases, except where the taint was inherited from various collateral relatives when the disease ran a severe course.

6. The inherited taint occurred relatively as often in older as in younger patients.

7. The author was very rarely able to verify the Brehmer law.

Routes of Infection in Tuberculosis. By Dr. J. Bartel, of Vienna.

In animals we are able to demonstrate in the lymph glands, in addition to the manifest tuberculosis with specific tuberculous changes, a stage of "lymphoid" tuberculosis in which the glands show mainly lymphocytic hyperplasia or are apparently "unchanged." The existence of such a "lymphoid" stage can be demonstrated in man also.

Attempts at immunization, performed according to the observation of a possibility of a cure of the tuberculous infection in the "lymphoid" stage, gave in combination with reinfection the following results:

"Signs of increased tendency toward, then of increased resistance and finally of complete immunity.

"Processes of complete cure in organs afflicted with 'manifest' tuberculous changes.

"Mainly 'manifest' tuberculosis of the lungs with the bronchial lymph glands and cavities in the lungs.

"But also isolated 'manifest' tuberculous disease of the lungs, the portals of entrance remaining perfectly intact and all opportunity of direct lung infection being excluded."

Under certain conditions, therefore, tuberculosis bears the character of a "cryptogenetic" infection.

A similar condition we must also expect in the domain of human pathology, according to the laws of natural immunity. Therefore, if we only consider the signs of "manifest tuberculosis" during a postmortem examination, we do not have sufficient facts as a reliable basis upon which to judge the portal of entrance; we must also consider the signs of "lymphoid tuberculosis." As far as we can judge at this time, the infection from pharynx, stomach and intestines is far more frequent, particularly during early life, than has generally been considered. Of less importance, as compared with general hygienic regulations, is the constant dispute concerning the more frequent

mode of infection, whether due to swallowing or inhalation, inasmuch as it is difficult to judge the relative effects of deglutition and aspiration.

Out-door Treatment of Surgical Tuberculosis. By Dr. Forest Willard, Philadelphia.

Out-door life, night and day, is as essential in the treatment of tuberculosis of bones and joints as in medical cases.

Early diagnosis, with treatment by sunshine, fresh air, rest and proper mechanical and surgical procedures, will prevent, and cure without deformity a large majority of cases of joint diseases—25,000 doses of pure air in 24 hours infinitely better than 3 doses of nauseous drugs that disturb digestion; 4,000,000 to 5,000,000 cubic feet of air consumed.

Tubercle bacilli die in sunshine, but thrive in darkness, vitiated air and filth. Inhibited by cold. Cold increases appetite, nutrition and circulation and encourages exercise and sleep—color, weight, strength and hemoglobin increase. Change from seashore to mountain desirable; 90 percent of joint cases poor.

Surgical sanatoria and hospitals separate from pulmonary cases needed. Constructed so that bed can be thrown, by window sashes, either in-doors or out-doors, thus giving warm room for surgical dressings and needed care—aseptic to prevent fatal mixed infection. Joint cases require level ground for crutches. Tents, hot in summer, cold in winter. Open barracks and wooden shacks. Porches roomy for beds, connected with private rooms or with hospital wards—open in summer—glass-inclosed in winter—large windows. Bed frames. Wheeled litters. Screens, awnings; roof gardens. Portable cottages; day camps near cities; forest schools for patients with hereditary tendencies.

Home treatment:

Open windows—head out of window—window tents. Protection from cold—newspapers under mattress, plenty of clothing. Good food important. Care in selection of situation necessary. Many country houses most unsanitary.

Kidney, pelvic and visceral tuberculosis require the same treatment.

The Importance of, and how the State of Minnesota Cares for Its Indigent Children Suffering from Tuberculosis of the Bones and Joints. By Dr. Arthur J. Gillette, St. Paul.

In 1897 the Legislature of the State of Minnesota first appropriated money for the State care of indigent crippled and deformed children. There being no precedent, the State was reluctant to take such a step. Since 1897 a number of States have made similar appropriations. At the present time it ought not to be a difficult matter to secure money from every State in the Union to treat and educate this class of sufferers.

It is of special importance, for it is found that about three-fourths of these crippled and deformed children are suffering from tuberculosis of the bones and joints. Many of them have complications of tuberculosis of the lungs, intestines, etc., and a very large percentage of them have abscesses and running sores, which not only contain bacilli of tuberculosis, but other infectious micro-organisms. Many of these children attend public school, and no provision whatever is made to protect the well children in the school-room or prevent contagion in their own families.

It takes at times a number of years to cure a child suffering from tuberculosis of the bones and joints, and the educational feature is a very important one. They must be educated, and they should have special instruction

along a line of work which would be useful later, that they may be self-supporting.

With the exception of a few States and a few large cities, there is no provision to prevent contagion or treat persons suffering from tuberculosis of the bones and joints.

Fresh Air Combinedtwith Hyperemic Treatment in the Management of Complicated Surgical Bone Tuberculosis in Adults. By Dr. Willy Meyer, New York.

The beneficial influence of fresh air in surgical bone tuberculosis in children is generally recognized. Not so in adults. In the latter, radical operation has been the usual treatment up to date and will probably continue so wherever saving of time is a factor to be considered or sufficient means are not at hand.

The histories of three cases of complicated surgical bone tuberculosis in adults are given to demonstrate how much can be accomplished even in usually intractable cases, especially if combined with proper and faithful hyperemic treatment in its various forms.

The plea is made to set aside in the sanatoria now designed for patients suffering from pulmonary tuberculosis at least two wards (male and female) for the treatment of adult cases of surgical bone tuberculosis whieh, for various reasons, could not or would not be subjected to operation. Of course, the attending doctors and nurses of such wards should fully master the details of hyperemic treatment.

The Surgical Treatment of Tuberculous Sinuses and Their Prevention. By Dr. Emil G. Beck, surgeon to the North Chicago Hospital, Chicago.

Diagnosis.—Successful surgical treatment of tuberculous sinuses depends upon a correct anatomical diagnosis. The boundaries and all ramifications may be clearly shown by radiographs obtained in the following method: The fistula is injected with a 33 percent bismuth-vaselin paste, which has been liquefied by heating and which quickly solidifies after injection.

Treatment.—The injection of bismuth-vaselin paste has proven to be of even greater value in healing tuberculous sinuses and abscess cavities, including empyema of the pleura. Cases which for years have resisted the most skilful medical and surgical treatment have ceased suppurating and healed within a few weeks. Where a sequestrum is the focus of disease, it is usually necessary to remove it. Bismuth subnitrate is an ideal material for this method of treatment, being bactericidal, slowly absorbed and practically nontoxic.

Prevention —Fistulous tracts may be prevented by opening the pointing cold abscess by an incision $\frac{3}{4}$ cm. in length, evacuating the pus, and at once refilling the abscess cavity with a 10 percent bismuth-vaselin paste, and not sealing the opening. This prevents secondary infection, which formerly contraindicated the incision of tuberculous abscesses.

Collective report of cases treated by this method during the past five months in general hospitals, hospitals of the United States Army and Navy and by general practitioners.

Surgical Tuberculosis. Dr. E. H. Bradford, Boston.

The treatment of tuberculosis is dependent for its ultimate result upon the success in establishing an immunity which protects from further tubercular invasion. This is equally true when the tissues attacked are or are not accessible to surgical interference. When the tissues invaded are placed

under suitable conditions, healing takes place and the affected tissues become cicatrized. The detritus of diseased tissues is either thrown off or becomes encapsulated.

In tissues within the reach of surgical interference the surgeon is to decide whether the healing process can be hastened by removing the affected tissue or the detritus. This depends upon the tissues affected and the anatomical situation of the parts affected.

These considerations are particularly important in bone tuberculosis and tuberculosis of the joints, for the reason that bone is a tissue that cicatrizes slowly and the articulations are especially exposed to injury which is unfavorable to the healing of the tissues affected by tuberculosis.

In joint tuberculosis it is especially important to see that the tissues are protected from trauma.

The treatment of surgical tuberculosis consists in operative interference and the promotion of healing by protecting the tissues, in addition to furnishing such measures as are useful in combating tuberculosis in general.

Obliteration of Tuberculous Bony and Articular Cavities with Mosetig Paste.

Dr. Nové-Josserand (University of Lyons) reports 16 cases of tuberculous osteitis and 10 cases of tuberculous arthritis treated by evacuation or resection, followed by the injection of Mosetig's iodoformized mixture. Immediate union was obtained in 7 cases of osteitis and in 1 case of arthritis. In most of the remaining cases complete recovery ensued in about a month. Prolonged suppuration was observed in only 2 cases of resection of the hip and in 1 resection of the knee.

The interest of these observations lies in the fact that these satisfactory results were obtained by careful evacuations of the lesions without the extensive scraping recommended by Mosetig and, in the case of resections, with preservation of the articular capsule. The method of obliteration with the iodoformized mixture is therefore compatible with conservative operations and does not jeopardize the ultimate functional integrity of the part.

The Importance of Immobilization in Tuberculous Arthritis. By Prof. Dr. A. Codivilla, Royal Orthopedic Institute of Bologna.

Dr. Codivilla's views are in accord with those expressed by the body of surgeons at the various International Congresses, that the treatment of tuberculous arthritis should be conservative since operative measures only remove a focus of bone disease and leave the joint infiltrated. To this there are exceptions. Perfect immobilization (the objections to which are due to faulty technic and irrational application) is the greatest help to cure. Atrophy and articular rigidity he ascribes to the tuberculous process, since they occur when the part is not immobilized. That fixation only produces a small part of the rigidity and will be of advantage in increasing the ultimate use of the joint is indicated by the fact that an articulation in a state of contraction offers much less resistance to straightening after a period of immobility than before. Plaster casts for spondylitis are injurious in hindering development of chest, etc., but in the greater number of cases and during the invading process these objections are outweighed by the advantages to the local process by immobilization.

The measure must be adopted at the first signs of injury. Therefore, the initial signs should be studied, X-ray employed and the diagnosis more frequently confirmed by tuberculin injections. The immobilization should

be complete throughout the period of inflammatory symptoms and motion ultimately introduced very gradually. No rule can be expressed for this.

Dr. Codivilla's method in coxitis is, in the so-called "florid" stage, to keep the patient in bed with weights only for a period of observation. The part is then rendered immovable by a plaster cast with Kappeler's stirrups to continue the traction. When acute symptoms have entirely subsided, the traction is removed and later on a new cast is applied, leaving the foot free and permitting the weight of the body provided the radiographic shade is dense and the articular lines regular. After a period this is again removed and the patient for a variable time kept in bed with extension, while massage of the leg and exercises of the knee-joint are employed to keep a balance of circulation in the limb. Then a new plaster cast reaching to the femoral condyles is applied. This prevents any motion with the exception of rotation, and the joint now bears the weight. Finally, an adjustable leather apparatus may be substituted so that massage or passive motion can be practiced.

Incisions or punctures of abscesses do not interfere with immobilization. The formation of small abscesses may be favorable. A mixed infection is to be avoided by antisepsis. Openings can be made in the cast.

In overcoming contractures and deformities Dr. Codivilla says there should be as little traumatism as possible. Resistance of the soft parts should first be overcome. Traction neurotomies and aponeurotomies may be required. Then the modification of the endo-articular deformities will not require any particular force.

He describes his method of traction by means of plaster casts in these cases.

The value of immobilization of the joint with plaster cast is greatly increased by employing one of the methods of traction, because the voluntary and reflex muscular contractions which would bring the bones of the joint together and so cause trauma in the diseased part is overcome. In the "florid" stage this force should be continuous.

Immobilization (produced by extensive and well-modeled casts) combined with traction is, according to Dr. Codivilla's experience, the best method for the cure of tuberculous joints and spondylitis.

Vaccine Therapy in Joint Tuberculosis. By Dr. Edward H. Ochsner, B. S., Chicago.

Vaccine therapy in joint tuberculosis should never be employed unless controlled by careful reading of the opsonic index and should always be associated with other recognized methods of treatment, such as fresh air, suitable food, immobilization of the joint, prevention of secondary infection, etc.

If thus employed we can obtain a very considerable percentage of perfect anatomic and functional cures, because the vaccine treatment secures a healing with a minimum amount of connective-tissue formation.

The Treatment of Tuberculous Hip Disease by Weight Bearing and Fixation by the Lorenz Short Hip Spica. By Dr. H. Augustus Wilson, Professor of Orthopedic Surgery, Jefferson Medical College, Philadelphia.

Weight bearing is conducive to the benefits afforded by out-door life. Constitutional activity prevents circulatory stasis. Confinement and inactivity favor atrophy from disuse. Weight bearing without fixation, under most favorable circumstances, may result in recovery, but with anky-

losis in deformed postures. Weight bearing with Lorenz short hip spica facilitates employment of out-door life, shortens time of treatment. Results show full function when used in suitable cases. Rapid recovery in some cases from abscess formation, and in others slow but permanent recovery. Beck's bismuth injection into sinus tracts. Sound ankylosis in cases previously confined in bed or where there was atrophy from disuse produced by using crutches. Muscular development of atrophied leg often demands frequent changes of casts, thereby indicating the benefits obtained. Weight bearing with fixation aids in securing the beneficial influences of Bier's hyperemia. Constitutional treatment, diet. Pathological dislocations may occur with improper position of fixation. Most favorable posture is that of twenty degrees of flexion, twenty degrees of abduction, and five degrees of external rotation. Method does not appear applicable to debilitated patients without temporary aid of crutches. Summary of cases treated by this method during six years.

Tubercular Arthritis of the Hip-joint. Dr. Stephen H. Weeks, Portland, Maine.

Treatment: Local and constitutional.

The *local treatment* is divided into mechanical and operative. The great principle of local treatment is rest to the affected joint. This may be secured by traction and fixation, one or both according to indications.

Constitutional Treatment.—If there is one point that has been emphasized by the newer ideas on the treatment of tuberculosis, it is that everything must be done to strengthen the defences of the system against the encroachments of the tubercle bacilli; whether it is pulmonary tuberculosis or tuberculosis of joints, the salient idea is to increase the vital resistance by fresh air, sunlight and proper nutrition. Remarkable results have been achieved in recent years in cases of tuberculosis of the various joints by an out-door life, particularly at the seaside, and without resort to operative measures.

In the Bradshaw lectures, Mr. R. J. Godlee, of London, expresses himself in general as favorably inclined toward the new vaccine therapy in the treatment of tuberculosis. At the present time all we can say is that it may prove a valuable adjunct to other treatment.

ABSTRACTS.

I. TUBERCULOUS LESIONS OF BONES, JOINTS AND TENDONS. GENERAL ARTICLES ON TUBERCULOSIS.

A Psoas Abscess Mistaken for a Case of "Acute Abdomen." W. P. Coues. Boston Med. and Surg. Journal, June 4, 1908, p. 868.

A Rare Case of Tuberculosis of the Bones in an Infant. A. Mühlenkamp. Münchener med. Woch., April 14, 1908, No. 15.

The Treatment of Coxitis. P. A. McIlhenny. New Orleans Med. and Surg. Journal, February, 1908.

Treatment of Hip Disease. Report of Progress in Orthopedic Surgery. E. H. Bradford. Boston Med. and Surg. Journal, Feb. 20, 1908, page 257.

Treatment of Hip-Joint Disease. W. LeM. Wills. California State Jour. of Med., January, 1908.

Resektion des tuberkulösen Ellenbogengelenks. W. Lossen. Deutsche Ztschr. f. Chirurgie, XCII, Nos. 1–3, February, 1908.

Case of Tuberculous Arthritis of the Knee, Apparently Much Aggravated by Bier's Congestion. J. J. A. Van Kaathoven. Therapeutic Gazette, Detroit, March, 1908.

Report of Calmette's Ophthalmo-reaction and von Pirquet's Cutaneous Tuberculin Test. By Lenhartz. *Aerztlicher Verein in Hamburg*, 12. Nov., 1907. *Ref. Zentralblatt für chir. und mech. Orthopädie*, 1908, p. 188.

Examination of 111 people. Result: Of thirty-seven obviously tuberculous patients twenty-two showed both reactions always positive. Fifteen had been treated previously with tuberculin; in these the reaction was negative or slight, due to the amount of injections.

Five of 11 patients which were clinically free from tuberculosis, showed positive reactions, all of whom were affected by hereditary disease.

Of sixty-three cases in which tuberculosis was suspected, twenty-three showed positive reactions. (Forty-five adults, eighteen children.) Eighteen of these twenty-three were affected by hereditary tuberculosis. The Pirquet test of forty adults was negative (according to Pirquet adults are said to show almost always this reaction positive, because they have rather generally acquired tuberculosis).

In several cases L. has also tested the reaction of "Alt tuberkulin" and always observed elevation of temperature —*H. Bucholz, Boston.*

The Plaster-of-Paris Bed and its Use in the Treatment of Pott's Disease. J. D. Ghiulamila, Bukarest. *Spitalul*, 1907, Nr. 15, p. 301. *Ref. Zentralblatt f. chir. und mech. Orthopädie*, 1908, S. 163.

G is very fond of the plaster-of-Paris bed in the treatment of Pott's disease and considers that immobilization and support of the affected parts is much better obtained than by the use of braces and other supporting apparatus.

Manufacture of a good plaster-of-Paris bed is not difficult and can be made by any physician anywhere. The patient will be laid on the abdomen so that shoulders, head and lower extremities are supported by firm pillows. The head and buttocks will be covered with gauze bandages thickly smeared with plaster-of-Paris paste, and applied smoothly to the body. After the plaster is hardened belts may be fixed on the anterior surface. It is possible to combine in the bed the immobilization with the extension of the head. Whenever desired the patient can be laid on the abdomen and the bed removed to look at the affected part or to puncture or to inject an abscess. Children can be easily carried and live out of door.—*H. Bucholz, Boston, Mass.*

Pott's Disease and Accidents in Working. By *Dervaux. La medicine des accidents du travail tome VI, No. 2. Ref. Centralblatt für chir. und mech. Orthopädie,* May, 1908. p. 230.

In the introduction D. emphasizes the difficulties of the diagnosis of Pott's disease in adults. In spite of extensive destruction and very large abscesses gibbus may be absent, such patients may even be able to work hard as is shown in same cases reported in this paper. Such a patient is in more danger from accidents than a healthy person. In cases of accident insurance it should be acknowledged that the accident is the chief cause of death or sickness, not Pott's disease.—*H. Bucholz, Boston, Mass.*

The Treatment of Tubercular Coxitis in Childhood. By Schanz. *Archiv. für Orthopedie.* Bd. VI, H. 2–3.

Ambulatory treatment in an appropriate cast is advised.

Abscesses are treated by aspiration and injection. Their long continued suppuration threatens the life of the patient, resection is advised. Ankylosis in a bad position is to be corrected by osteotomy.—*Walter G. Stern, Cleveland, Ohio.*

Report of Three Years, Work at the Sea Breeze Hospital for the Treatment of Surgical Tuberculosis in Children. By Leonard W. Ely, M. D., and Brainerd H. Whitbeck, M. D., New York. *Medical Record,* March 7, 1908.

A detailed report of cases treated at the Sea Breeze Hospital at Coney Island. Fresh sea air, good food and orthopedic appliances are the mainstays of treatment. The writers are of the opinion that children with tuberculous glands or joints do better at the seashore than elsewhere.—*R. R. Fitch, Rochester, N. Y.*

General Surgical Considerations of Joint and Bone Tuberculosis. Joseph Wiener, M. D. *New York Medical Journal,* April 4, 1908.

Omitting the spine, Dr. Wiener enumerates a few of the classical signs and symptoms of tuberculosis in other parts of the osseous system. He touches on the subject of prognosis; and outlines briefly some of the established methods of treatment. In many cases he advocates the injection of iodoform oil.—*C. W. Hoyt, Rochester, N. Y.*

Experience with the V. Pirquet Skin Tuberculin Reaction. By N. Goebel. *Munch. med. Woch.,* Jan. 28, 1908, No. 4.

According to part of the experience up to date, it is established that we possess valuable help in the Pirquet inoculation and in the Ophthalmic reaction. In children from 1 to 12, the author holds that the positive occur-

rence of the reaction is almost proof positive. In adults also a positive reaction renders a positive conclusion probable, and where the reaction is negative after repeated inoculations, tuberculosis may be ruled out.—*Henry O. Feiss, Cleveland, Ohio.*

A Critical Study of the Clinical Value of the Ophthalmo-reactions. By C. Kleinberger. *Münchener medizinsche Wochenschrift*, No. 52, Dec. 24, 1907.

Author reports on 61 cases in which he used the infusion. He worked on 3 classes of cases. The first class was the certainly tuberculous (9 cases); the second was the suspectedly tuberculous; (6 cases) the third, non-suspected tuberculosis (46 cases). In the first class all reacted. In the second only 2 reacted, and in the third 36 reacted (i.e., 78 percent). He states that in spite of the small number of cases examined, his observations showed that repeated infusions of tuberculin may lead to error and that the result of our experience with ophthalmic reactions in proven cases of tuberculosis does not justify its practical application as a differential diagnostic method.—*Henry O. Feiss, Cleveland, O.*

Tuberculosis of the Patella. By John B. Murphy, M. D. *Surgery, Gynecology and Obstetrics*, March, 1908.

Tuberculosis of the patella is rare and is probably due to the fact that the patella has no epiphyseal circulation. The author believes that tuberculosis of this bone is always secondary.

A focus of disease in the patella usually develops in early adult life, and the most marked physical sign is enlargement.

In diagnosis the X-ray may not help in very early cases, but it is of value later.

Treatment.

If the cavity is small the sequestrum is removed and the cavity curretted and filled with a glycero-gelatin-formalin plug, in other and severer cases the patella should be extirpated *in toto.*

The author produces a chemical inflammation in the joint from 7 to 10 days before operation, and thereby develops a local immunity.

His operation consists in making a subaponeurotic excision of the patella, then a flap consisting of a portion of the quadriceps tendon and the vastus externus muscle is brought down and sutured into the patellar ligament.

The wound is then closed and the leg put in a posterior splint.

The author reports two cases with good results.—*Edward S. Hatch, New Orleans, La.*

Treatment of Spondylitis. By A. C. Wiener. *Zentralbl. f. Chir.*, Feb. 28, 1908.

W. considers that tuberculosis of the first to the fourth dorsal vertebræ offers the worst prognosis on account of the difficulty in carrying out treatment by extension. He recites a case of fifteen years' duration in a 54-year-old woman, in which there was severe pain in the back and clonic twitching in the extremities, and details the methods by which he carried out the extension treatment, as follows: During the night extension was made in the usual manner; during the day, the patient sat for the greater part of the time in a chair to which a weight-and-pulley attachment was applied; to permit of walking while extension was maintained, he devised a trolley apparatus, which he describes. Complete cure is said to have taken place in about seven months.—*David Silver, Pittsburg, Pa.*

The Causes and Importance of the Position of the Foot in Pro- and Supination in Tuberculosis of the Ankle-joint. By Hoffman. Reviewed in *Arch. f. Orthop.*, Bd. VI, H. 2–3, p. 265.

In a review of 14 cases the author found that tuberculosis of the astragulo-navicular joint gave rise to pronation and abduction of the foot, while disease in the calcaneo-astragular joint is characterized by adduction and supination.

He proved these positions to have a mechanical basis by injecting these joints and finding that the foot tended to assume these same characteristic positions.

These positions are of great diagnostic importance for the diagnosis of the location and extent of the process. Continuous fixation in these positions, together with other signs of tuberculosis, speak for a widespread destruction of the joint. If these signs are absent, the chances are that the disease has not run a severe course and probably involves only the synovia and capsule.—*Walter G. Stern, Cleveland, O.*

II. PARALYTIC DISEASES AND THEIR DEFORMITIES. TENDON SURGERY.

A Case of Traumatic Telangiectasis of a Tendon. Arthur T. Legg. Boston Med. and Surg. Journal, July 16, 1908, p. 85.

Poliomyelitis mit Lähmung der oberen Extremitäten. Zappert. Deutsche med. Woch., 1907, 51, page 2165.

A propos des transplantations nerveuses musculaires et tendineuses dans le traitement des paralysies. Robert Jones. Comptes rendus du 20e Congrès français de Chirurgie, 1907.

Infantile Paralysis Simulating Meningitis; Tendon Transplantation. A. J. Turner. Australasian Med. Gazette, Sydney, March, 1908.

Repair of Divided Tendons. N. E. Jobes. Indiana Med. Journal, Indianapolis, March, 1908.

Three Cases of Spastic Paraplegia in One Family. E. Hagenbach-Burckhardt. Zentralbl. f. Kinderheilkunde, March, 1908, No. 3.

Sopra un caso di distrofia ossea d'origine nervosa. Raggi. Archivio di Ortopedia, 1907, A. XXIV, fasc. 4.

Zwei Fälle von partieller Muskelatrophie an den oberen Extremitäten. Fürnrohr. Münchener med. Woch., 1907, 30.

Nerve Bridging. Report of One Successful Case. Alfred S. Taylor. Journal A. M. A., March 28, 1908, page 1029.

Epidemics Infantile Paralysis. By M. Allen Starr, New York. *Jour. A. M. A.*, July 11, 1908.

Epidemics of New York, 1907, considered. Its spread up the Hudson, and fifty miles along sound into Connecticut; (probably over 2,000 cases in all). Bacteriology by Simon Flexner.

Began in May, increased in June and July rapidly; the height in August and September, decline in October and December. New York, Brooklyn, Long Island City and Bronx, Staten Island, up Hudson, Stamford and Norwalk. *No cases in New Jersey* or Newark. Mortality of 6–7 percent

Hot dry weather. Other infectious diseases were not prevalent. Infantile did not follow another infectious disease. Onset with brisk, febrile attack occasionally with chill, vomiting, malaise, *general sweating*, general severe pain in limbs and back. Diarrhea frequently on second day. Mild fever, 7–9 days. Paralysis appeared on 3–4 day. Paralysis appeared suddenly in its full extent. Leg involved in large majority of cases. The motor-cells of the brain are at times affected. In no case was there permanent loss

of bladder control. Fatal cases due to respiratory-centre paralysis. Flaccid paralysis with loss of Faradic reaction.

The pain is due to the congestion of the gray matter of cord.

Improvement continues for two years. Mild cases may entirely recover. In sporadic cases death rare.

Blood cultures negative. No severe reaction. Infiltration of the vessel-walls of pig with lymphocytes more on the anterior surface of the cord, beginning and ending of cord; cell infiltration of gray matter. The exciting cause is probably a toxine.

Briefs of forty-four epidemics.

Prognosis.—Mortality in sporadic cases very low. If a case survives eight or ten days prognosis for life is good. Twenty-five percent of cases show complete recovery in epidemics. Sporadic cases show a much lower percent of complete recoveries.

Treatment.—Cupping along spine frequently but for very short periods. Ice-bags. Cold baths.

For pain. Dover's powders. Quiet.

Purgative. Diet of milk.

After two weeks strychnine, manipulation, massage, rubbing. Warm bath two in day for one-half hour. Electricity, galvanic and faradic.

Braces to prevent deformity applied early.

The Epidemiology of Acute Poliomyelitis. L. E. Holt and Bartlett. *Amer. Journal of the Medical Sciences.* May, 1908.

Holt and Bartlett have made a searching analysis of thirty-five epidemics of acute poliomyelitis with special reference to the distribution of cases. They have reached the conclusion that beyond question, acute poliomyelitis is an infectious disease. They further believe that the disease is communicable, although only to a slight degree.

The Treatment of Paralytic Club-Foot. By Topuse. *Arch. f. Orthopedie*, Bd. VI. H. 4.

The large number of plastic operations devised for the correction and cure of this deformity is a proof of their inefficiency. Such operations must have two distinct ends in view.

1. The permanency of the foot in the physiological position.

2. The possibility of active motion. The operation must also be simple and rapid so that the healing of the wounds in a field whose nutrition is so seriously impaired should be perfect.

An exact muscle status must be determined in advance but it must also be born in mind that a muscle which is seemingly totally paralyzed and does not react electrically, may at the time of the operation be found to be of good color and contain contractile muscle bundles; only its tone has been lost and not its power of contracture (Hoffa). The plan of the operation must therefore be such that it can be changed during the operation to take advantage of the discovery of such muscles.

The operative plans in present good favor are those of Vulpius, Deutschländer and Schanz. As far as Vulpius' operations are concerned they are so complicated tha t they can be used only in especially favorable cases, where they may give excellent results Deutschländer's operation often calls for a sacrifice of useful muscles which aught to be saved and used; it corrects the position but does not improve the function. Schanz dislocates and shortens the peronei and is not often successful. Topuse praises and advises

the use of a method first described by his chief Dr. Kofman of Odessa. It is, in brief, as follows:

Skin cut over tendo Achillis and dissection of same from os calcis to the muscle; division of tendon into two halves up to the muscle body; lengthening of the inner half of the tendon by means of a Bayer Z-incision; temporary closure of wound.

Skin incision upon the dorsum over the tibialis anticus from the lower third of leg to below annular ligament. The extensor communis is shortened a great deal and the extensor hallucis only slightly. A tunnel is then made under the skin over the external malleolus and the outer half of the tendo Achillis is brought through and sewn to the extensor communis just below the annular ligament.—*Walter G. Stern, Cleveland, O.*

Nerve Anastomosis in Infantile Paralysis. By Karl Osterhaus, M. D., Norfolk, Virginia. *Medical Record*, July 11th, 1908.

The possibilities from operations of different characters is discussed, and résumé of the several methods of nerve anastomosis especially gone into. The classification of which is given after Frazier as follows:

1. End-to-end anastomosis of the peripheral segements of the affected nerve with the central end of a segment split from the unaffected nerve.
2. Lateral anastomosis of the peripheral segment of the affected nerve with the unaffected nerve.
3. Lateral anastomosis of the central end of the segment split from the unaffected nerve with the diseased pheripheral nerve.
4. End-to-end anastomosis of both central and peripheral ends of the affected nerve with the split segments of the unaffected nerve (Bazil Kilvington).
5. Lateral anastomosis of one or more muscular branches of the affected nerve with the unaffected nerve.

He states that nerve grafting should not be attempted until the expiration of one year following the onset, during which time much improvement may be expected from general stimulative therapeutic measures, and further states, that the result of a nerve anastomosis largely depends on such measure being faithfully carried out following operation.

He concludes with the report of one case, which seems to have been much benefited, though as yet sufficient time has not elapsed to fully judge of the result, and it is to be hoped that we will hear further of this case.—*John Dunlop, Washington, D. C.*

On the Significance of Tendon Transplantations. By Redard. *Zentralbl. f. chirurg. u. mechan. Orthopedie*, Bd. II, Heft 1.

Redard draws his conclusions from his own material, not from the material of others. According to his experience, the operation can at least, in part, restore the balance of the muscles, can also renew certain movements, can improve the function, can maintain the correction of the deformity and can prevent its recurrence. A complete rehabilitation is not to be expected. The best results are offered in the descending and total transplantations when done into the periosteum. Silk tendons are only to be used in the exceptional cases. The indications for tendon transplantations are enumerated.—*Henry O. Feiss, Cleveland. O.*

The Value of Arthrodesis. By Vulpius. *Munch. med. Wochenschr.*, 1908, S. 7.

The author in his work on tendon transplantation has not lost sight of the value of arthrodesis. The operation should be reserved for a definite condition of paralysis when we are certain that the advantage to be gained is

greater than the damage already present. Author cites his satatistics as to improvement, stating that 50 or 60 percent gained a fixation of the ankle, 75 percent gained a fibrous or bony anchylosis of the knee, and 80 percent gained a bony or firm fibrous anchylosis of the shoulder.—*Henry O. Feiss, Cleveland, O.*

Inflammation of the Circumflex Nerve. By Chas. F. Disen, M. D. Minneapolis, Minn.

Dr. Disen gives a concise description of the subjective symptoms, diagnosis and treatment of this very interesting subject. His results seem to show that rest is the preeminent part of the treatment, but that it might be supplemented by effleurage, and in the later stages of treatment he advises the galvanic current. He decries the use of strong electrical currents, kneading and exercises.

Cases treated with care should regenerate new fibres in five weeks.

In the latter stages, say, after the fourth week he advises careful passive manipulation.—*John Dunlop, Washington, D. C.*

The Uses of Silk Ligaments In Addition to Muscle and Tendon Transference in Infantile Paralysis. By Robert Soutter. *Boston Medical And Surgical Journal,* June 4th, 1908.

"The writer wishes to show a method he has used to overcome deformity in paralytic cases to supplement tendon and muscle transplantation." The use of silk in the surgery of the tendons was first suggested by Lange. Silk causes the formation of a tough tissue, which surrounds it, and extends from its origin to its insertion. "In other words, a strong natural tendon is produced." The fault of old methods of tendon transplantation was that transplanted muscles were inserted into paralyzed tendons, which, in time, stretched. When transplanted muscle cannot be reasonably expected to correct a deformity, although it will take up the new motion, the use of silk is suggested. When through extensive loss of muscular power a joint lacks stability the use of silk guys is suggested, in preference to arthrodesis.

The author emphasizes the fact that operative treatment should not be considered in the early stages of paralysis.

He says two points cannot be too often emphasized in infantile paralysis. First of all deformity can be prevented by careful treatment. Second, no operation except some simple operation to cure deformity should be undertaken until massage, electricity, and best of all, careful muscle training has been used for three or four years.

Doctor Soutter then describes two methods of attaching his silk ligament to the bone by means of quilting into the periosteum. He says also that it is important in the use of silk ligaments that in children, at least, one end should be attached to some soft tissue, but it is not advisable to attach the ligament to the tendon of a paralyzed muscle, for in time these will stretch. Muscle training is an important after-treatment. It is claimed that silk ligaments will stiffen an ankle-joint sufficiently to prevent lateral motion without interfering with dorsal flexion, which is so necessary in walking. It is thus to be preferred to arthrodesis.

To sum up the article recommends the use of silk not only to lengthen tendons, and to allow of their attachment to bone, but he uses silk, and cites cases when he has used it, to anchor bone to bone, or member to member, as the foot to the leg.

He does not mention the great liability to infection in these cases where silk is used. *A. Mackenzie Forbes, Montreal, Canada.*

III. INFECTIOUS ARTHRITIS.

Action of Prolonged Heat on Joints Infected Experimentally. Report of Progress in Orthopedic Surgery. E. H. Bradford. Boston Med. and Surg. Journal, Feb. 20, 1908, page 258.

Symptomatology and Diagnosis of Acute Articular Rheumatism. Philip King Brown. Journal A. M. A., March 7, 1908, page 739.

Differential Diagnosis of So-Called Chronic Rheumatism. E. S. Hatch. New Orleans Med. and Surg. Journal, January, 1908.

Rheumatism in Children. M. Cosgrave. California State Jour. of Med., February, 1908.

Six Cases of Gonococcic Arthritis Treated with Antigonococcic Serum. A. Perez-Miro. Therapeutic Gazette, Detroit, April, 1908.

An Improved Treatment of Gonorrheal Arthitis (So-called Gonorrheal Rheumatism). By E. C. Titus, M. D. *New York Med. Record*, July 25, 1908.

Dr. Titus gives a brief résumé of a method of treating gonorrheal prostatitis and vesiculitis by means of a specially constructed insulated vacuum electrode, directly applied, thereby destroying the seat of the disease, and the font of the poison, which is the cause of the arthritis. He states that it is a well-established fact that the gonococcus can not live outside of a mucous surface, and states further, that after it has been proven that the inflammation has ceased in the prostate and seminal vesicles that he treats the involved joint directly.

"The actinic action of the vacuum tube-discharge exerts a direct bactericidal effect upon deep-seated gonococci. In addition there are generated on the surface of the vacuum electrode, when in contact with the parts or tissues of the body, nascent nitrous acid and ozone, as a result of the disassociation of the air between the surface of the tube and the lining membrane of the part or cavity, these, together with the actinic discharge of the vacuum tube, are carried into the tissues to a depth of from 2 to 6 mm. by the action of the high-potential currents.

Dr. Titus reports no cases, nor is there appended the bibliography of this interesting subject.—*John Dunlop, Washington, D. C.*

The Treatment of Gonococcus Arthritis by Injections of Dead Gonococci, and the Clinical Reaction which Follows the Injection. By E. E. Irons. *Boston Med. and Surg. Journal*, July 2, 1908, from *Archives of Internal Medicine* for May, 1908.

Conclusions based on 40 cases of gonococcus infection, including 30 cases of arthritis. The results so far seem to indicate that in certain cases of gonococcus arthritis recovery can be hastened by the injection of dead gonococci. No harm has been seen to follow the injection, and it is possible that the use of larger doses will be found desirable in some cases. The treatment should be carried on in conjunction with other general measures, such as rest, aspiration of joints distended with fluid, massage of the prostate, and other surgical and general hygienic treatment.

The reliability of the clinical gonococcus reaction as a diagnostic procedure will also be determined only after many tests.—*E. W. Ryerson, Chicago, Ill.*

IV. INFECTIOUS BONE DISEASE, EXCEPT SYPHILIS.

Ein Fall von doppelseitiger Schleimbeutelentzündung an der Ferse bei Exostosenbildung am Calcaneus. Unverfehrt. Dissertation, Kiel, 1907.

Early Diagnosis of Acute Infectious Osteomyelitis and Total Extirpation of the Scapula. E. Kœrber. Archiv f. klin. Chir., Berlin, LXXXV, No. 4, 1908.

Two Cases of Subacute Infective Epiphysitis. E. M. Corner. Med. Press and Circular, London, April 1, 1908.

Removal of the Whole or a Part of the Humerus. E. M. Sala. Am. Jour. of Surgery, New York, February, 1908.

Grafting of Fibula to Tibia. R. A. Stoney. Medical Press and Circular, London, Feb. 26, 1908.

Acute Osteomyelitis of the Shaft of the Humerus. Removal of the Shaft. Complete Reproduction of the Bone. C. L. Scudder. Surgery, Gynecology and Obstetrics, February, 1908.

V. SYPHILIS AND METABOLIC DISTURBANCES CAUSING BONE AND JOINT DISEASE.

Die characterischen Formen der Arthritis deformans bei den verschiedenen Gelenken im Röntgengramm. Settegast. Verhandlungen der deutschen Röntgengesellschaft, Band III.

Beitrag zur Pathologie des Gichtstoffwechsels. Unna. Diss., Leipzig, 1907.

Spondylitis Deformans; With Clinical Reports of Five Cases. Theodore Diller and George Wright. Journal A. M. A., May 30, 1908, page 1768.

Ossifying Myositis in the Brachialis Anticus after Luxation of the Elbow-joint. P. Frangenheim. Deutsche med. Woch., No. 12, March 19, 1908.

Peculiar Form of Progressive Fibrous Myositis. H. Lorenz. Wiener klinische Wochenschrift, April 2, 1908, XXI, No. 14.

Progressive Ossifying Myositis in a Boy of Eleven. C. A. A. Dighton. Edinburgh Med. Journal, April, 1908.

Ein Fall von Osteomalacie. Veit. Verein der Aerzte in Halle a. S., 17 Juli 1907.

A Case of Achondroplasia. Macewen. British Med. Journal, Dec. 7, 1907, page 1646.

Pathologische Luxation des linken Ellenbogengelenkes infolge von Syringomyelie. Wendel. Münchener med. Woch., 1907, 34.

Fall von kongenitaler Lues. Preiser. Aerztlicher Verein in Hamburg, 12 Nov. 1907.

Statistical Contributions to the Question of the Spread and Etiology of Rickets. By Pfister. *Abstracted in Arch. für Orthopedie* Bd. VI, H. 2–3.

Official Italian statistics show many provinces where the hygienic and sociologic conditions were the poorest imaginable to be remarkably free from rickets whilst others where all conditions were much better had a higher death and morbidity rate from this disease. No explanation is offered.—*Walter G. Stern, Cleveland, O.*

Bone Changes in Scurvy and Barlow's Disease. By Looser. *Abstracted in Arch. f. Orthopedie,* Bd. VI, H. 2–3.

The bone changes in scurvy are the greatest in the young and growing skeleton. Barlow's disease is a hemorrhagic diathesis caused by chronic nutritional disturbances and is identical with scurvy. In adults bone changes are rarely discoverable except where a previous fracture had left a deposite of callus.—*Walter G. Stern, Cleveland, O.*

Concerning Osteogenesis Imperfecta Congenita and Tarda. By Looser. *Abstracted in Arch. für Orthopedie,* Bd. VI. H. P. 2–3.

The following conclusions are given:

There is a lack of function in the otherwise normal endosteal and periosteal osteoblasts resulting in atrophy and lack of thickness of the bones. Calcification is also abnormal. At first the epiphyseal cartilages are normal but in

the later stages they undergo retrogressive metamorphosis. The bone which developes from the epiphyseal cartilage grows in a normal manner but is lacking in strength and amount. The bone-marrow seems normal except at points of fracture and infraction where it shows fibrous changes. The shortening and thickening of the long bones is due to fractures and infractions with their resulting callus formation. The usual underlying cause of the disease seems to be some unknown congenital dyscrasia.—*Walter G. Stern, Cleveland, O.*

Achondroplasia, By W. N. Bullard and A. W. George. *Boston Med. and Surg. Jour.*, June 25, 1908.

Clinical report of a case, with Roentgen-ray pictures of arm and hand. Absence of thyroid. Treatment by thyroid extract and bone-marrow. The pictures show retarded development of the epiphyses, with cup-shaped depressions in the ends of the diaphyses. There is not the same unevenness of outline as is seen in rachitis. Two classes of cases—those seen up to puberty without marked deformity, and those with marked deformity of the limbs, or in which there is a secondary joint-lesion apparent.

A short discussion of the subject precedes the report of the case. The pictures are excellent.—*E. W. Ryerson, Chicago, Ill.*

Treatment of Rickets. By Klautsch. *Zentralbl. f. Kinderheilk*, 1908, 3.

The author has used nucleogen in 8 children from 8 months to 3 years old who had rickets. The substance was made up of ferric acid nucleogen which contains 9 percent phosphorus and 15 percent iron organically combined. Arsenic enters into the acid nuclein molecule up to 5 percent. The drug is supposed to take the place of ordinary oils.—*Henry O. Feiss, Cleveland, O.*

Dislocation Backwards of the Ulna and its Relation to the So-called Myositis Ossificans Traumatica. By Machol. *Beitr. z. klin. Chir.* Bd. 56, Heft 3.

Writer states that over half of the cases of myositis ossif. traum. follow posterior luxation of the elbow. He saw a case of such ossification take place right under his eyes in his own clinic. The brachialis internus seemed to have a predilection for the ossification. Cases which are not reduced do not show the process. When the ossification begins, it begins early, perhaps in the first 4 weeks. On a basis of the Rœntgen pictures, the writer divided the cases into 3 types. In the first type, the shadow of ossification is in the soft part near the diaphysis of the humerus. Prognosis for this type is a greater spread of the bone and a disturbance of function of the joint. In the second type, we find the shadow in the soft parts in the joint-space and in relation to the proximal part of the diaphysis of the forearm. Functional disturbances do not take place because the new bone disappears in great part. In the third group, we again find the shadow near the diaphysis of the humerus. The new bone quickly atrophies and no connection is formed with the true skeleton. Therefore, there is no disturbance of function. Operative interference is, as a rule, only indicated when functional disturbances are present.—*Henry O. Feiss, Cleveland, O.*

Luetic Arthropathies. By Zesas. *Arch. für Orthopedie.* Bd. VI, H. 2–3.

A collective abstract from a clinical stand-point. For details the original is best consulted.—*Walter G. Stern, Cleveland, O.*

Arthritis Deformans Coxæ. By Preiser. *Arch. f. Orthopedie*, Bd. VI, H. 4,

In 60 percent of all individuals the trochanter is normally above Nélaton's line, often as much as from 3 to 9 cm. The cause of this is not a deviation from the normal of the femur, but rather a variation in the position of the ant. sup. spine and tuber ischii or the acetabulum. The author claims that this elevation may cause some static abnormality which can lead to a secondary arthritis deformans of the hip.

He divides the disease into—

1. Idiopathic.
2. Neuropathic.
3. Traumatic.
4. Secondary to previous coxitis.—*Walter G. Stern, Cleveland, O.*

Osteomalacia and Adrenalin. By R. de Bovis. *Semaine Médicale*, Paris, May 20, 1908, XXVIII, No. 21.

The recorded cases are reviewed—French, English and Italian.

The dose used by many has been much too large. But in many of the cases treatment was stopped because of toxic effects, but in others the large doses were successful. For instance, M. Bovis used about 5 to 6 times the dose.

One of the toxic cases was cured and remained cured from 7 months to delivery. Many of the cases improved, but relapsed after treatment was stopped.

Dose should be .0001 to .0003 in normal persons. But it is thought that osteomalitic patients have a heightened resistance and will stand large doses.

Experiments were done, removing the suprarenal gland from one side of a sheep and X-rays later showed porous bones, but there was no other evidence.

M. de Bovis thinks the evidence is not sufficiently convincing and recommends further trials of adrenalin in large doses.

Polyarthritis Chronica Deformans. By H. Curschmann. *Berl. klin. Wochenschrift*, 1906, S. 1091. Ref.: *Archiv für Orth., Mech. und Unfallchir.*, 1908, S. 257.

Without discussing the various theories of etiology, etc., C. gives in a very clear way the outlines of polyarthritis chronica deformans, a disease which is also called rheumatoid or atrophic arthritis. His remarks about his own experiences due to sex and age are very interesting. Among 167 cases he found 107 women. In 82 cases the disease started in the twelfth to thirty-third years; in one-fifth of them between the twelfth and twentieth years. In cases starting in early age he found often remissions and exacerbations, while later cases showed a more equally chronic character. C. thinks that the atrophy of the muscles, which always accompanies the changes in the joints, is not at all due to spinal lesions, because we never find any changes of reactions of the muscle fibres. He thinks that the same process causes the lesions of the joints, the atrophy of the muscles and also some changes of the skin, but he does not choose to give any explanation of this process. Several times he emphasizes that this disease has nothing to do with rheumatism.—*H. Bucholz, Boston, Mass.*

The Changes of Bones in Scorbut and in Barlow's Disease (Scorbut of Suckling Babies). By Looser. *Jahrbuch für Kinderheilkunde*, N. F. 62, H. 6. Ref.: *Arch. für Orth., Mech. und Unfallchir*, 1908, 256.

According to his own researches, L. thinks that Barlow's disease is quite identical with scorbutus in an etiological, symptomological and pathological

sense. Scorbutus shows the changes of bones which, as a rule, are found in the growing skeleton. In adults the change in bones is very rare, but is sometimes found in callus. The nature of Barlow's disease is a hemorrhagic diathesis due to chronic disturbances of nutrition. The fibrous change of the marrow is caused by hemorrhages, also the atrophy of spongiosa and cortical portions.—*H. Bucholz, Boston, Mass.*

Caries Sicca. By Dr. Morris B. Miller. *Meeting of the Philadelphia Academy of Surgery*, March 2, 1908.

Dr. Miller presented a case of a woman, 22 years old, who gave a history, following a long attack of typhoid complicated by pneumonia, of gradual loss of power at the shoulder, gradually progressing to muscular atrophy, complete fixation of the joint, with neuralgic pain in that region. Dr. Meyer, thinks this condition may be frequently diagnosed as arthritis, and raised the question whether or not excision would be warranted.—*C. W. Hoyt, Rochester, N. Y.*

The Present Status of the Etiology of Syphilis. The Spirochæta Pallida; Its Biology and Etiological Relation to the Disease. By Randle C. Rosenberger. *New York Medical Journal*, Feb. 29, 1908

Dr. Rosenberger reviews thoroughly the literature on the spirochæta, its morphology, occurrence in syphilitic lesions, inoculation experiments, and also describes various methods of staining. Summarizing all his references, the spirochæta was found in 958 syphilitic lesions out of a total of 1210. The highest percentage of positive results was in congenital lesions, where it was found in 123 out of 127 examined. The author concludes from his investigation that the spirochæta pallida is the probable cause of syphillis. —*C. W. Hoyt, Rochester, N. Y.*

Arthritis Deformans of the Hip. A Preliminary Report of a New Operation. By Fred H. Albee, M. D., New York. *Jour. Am. Med. Assn.*, June 13, 1908.

After discussing the pathology and symptomatology of the disease the author describes an operation devised to produce a permanent bony anchylosis of the hip-joint and relieve the pain. The operation is done through a long anterior incision along the inner border of the sartorius muscle. Blunt dissection is carried down to the capsule which is opened and the wound widely retracted. Any osteophytes surrounding the acetabulum are left *in situ* if possible on account of their bone forming tendencies and possible assistance in locking the joint. Then with a flat chisel the upper portion is removed in a line corresponding to the femoral neck, and the upper surface of the acetabulum is chiseled out flat so as to produce a corresponding surface of denuded bone which will approximate that on the upper surface of the head when the leg is abducted. If necessary to secure sufficient abduction the adductor tendons and muscles are divided through an open incision at their origin. Then with the thigh strongly abducted the wound is closed and the leg and trunk encased in a plaster spica from toes to axilla.

He has done the operation on five cases between 30 and 67 years of age, and pain has been relieved in every case. Those which have had time to recover are able to walk without pain with the aid of a cane, and one, a policeman, has been able to do the duties of a patrolman for nine hours a day for nine months.—*John L. Porter.*

Etiology of Chronic Nontuberculous Arthritis. A Preliminary Report. By H. W. Marshall, M. D., Boston, Mass.

Excluding all cases of undoubted infectious origin the author discusses the results of investigation of a series of cases of chronic arthritis from an etiologic point of view. Incidentally he calls attention to the discovery that ether anesthesia produced in many cases immediate improvement in the acute symptoms with the subsidence of swelling and edema, lasting from two days to two weeks and suggests a possible explanation in the increased excretion of nitrogenous products following etherization.

The cases in which this improvement was noticed were all cases in which the cause of the arthritis seemed to lie in some disturbance of metabolism, and those in which no improvement was observed following etherization seemed to be of infectious origin. Reference is made to the observations of Hoke and Andrews as to the influence of lactic acid milk on these cases and the possibility of an intestinal toxemia is admitted.

The work has not progressed far enough to admit of any very definite conclusions.—*J. L. Porter.*

Intermittent Claudication and its Relation to Disturbances of Mobility. By R. Bing. Reviewed in *Arch. f. Orthop.* Bd. VI, H. 2–3, p. 262.

This communication is a thorough and painstaking "collective abstract." Of the entire subject of intermittent claudication.—*Walter G. Stern, Cleveland, Ohio.*

Acute and Subacute Purulent Osteomyelitis of the Spine. By Mario Donati. Reviewed in *Arch. f. Orthop.* Bd. VI, H. 2–3, p. 262.

Thirty-five cases have appeared in recent literature to which list the author adds one of his own, which he describes with great minuteness. The paper closes with a careful review of the etiology, pathology, anatomy, symptoms, treatment, etc.—*Walter G. Stern, Cleveland, Ohio.*

The Anatomy of the Long Bones Relative to Certain Fractures. By Ralph Thompson. *The Lancet,* April 25, 1908.

This is the second of two lectures delivered before the Royal College of Surgeons of England by the Hunterian professor. It is a discussion of the way in which the main pressure is transmitted through the bones; the influence of this pressure upon the internal structure of the bone, and the influence of these lines of pressure upon the lines of fracture. It is a study of the buttresses, stresses and strains of the bones; an examination of the pressure lamellæ in relation to fracture showing that these greatly influence the line of cleavage. Although this lecture has to do so greatly with the internal structure of bones and the minute pads and buffers in relation to a joint cavity, there are many points of practical interest remaining for that fast disappearing class of students—the macroscopists.

In the study of fracture of the surgical neck of the humerus Professor Thompson says: "low fracture of the surgical neck of the humerus may be associated with dislocation of the humerus from the glenoid fossa and a correct appreciation of the strength and position of the inferior lip of the glenoid process, which may be termed the glenoid buttress, helps to explain this not infrequent occurrence. But whilst it helps to explain the occurrence of a dislocated shoulder with a fracture of the surgical neck of the humerus it explains very well the occurrence of a fracture of the surgical neck of the humerus in conjunction with the reduction of a dislocated shoulder. In, for example, Kocher's method of reduction of a dislocated shoulder direc-

tions are given that the shoulder shall be adducted. At this time also the humerus is being flexed and internally rotated and the inferior lip of the glenoid fossa is therefore not only coming into forcible contact with the surgical neck of the humerus but is also exerting a cutting action.

It will be well, therefore, for those who scoff at the method of reducing a shoulder-joint by exerting pressure upon the humerus with the stockinged foot to remember the existence of this glenoid buttress."

The arrangement of the internal structure of the bones as relating to fracture is interestingly stated in such paragraphs as this: "Very small pressure lamellæ are developed in the ends of the bones forming the acromio-clavicular joint in contradistrinction to the well-marked pressure lamellæ in the inner end of the bone. The arrangement, therefore, of the compact and cancellous tissue changes very materially in the region of the trapezoid ligament. We may, therefore, fairly conclude that it is only that part of the clavicle which lies internal to the trapezoid ridge which transmits pressure to the trunk from the upper limb. This, then, is the reason of fractures being more common, especially by indirect violence, in the middle third of the clavicle than in the outer third."

An examination of the points of pressure on the external surface of a bone will apparently show the position of the pressure lamellæ in the interior and conversely an examination of the latter will demonstrate the points of greatest pressure on the outside.—*A. Mackenzie Forbes, Montreal, Canada.*

A Review of Some Recent Work on Gout. By Alfred W. Sikes. *Practitioner*, March, 1908.

This article deals with the cause and rational treatment of gout. It begins, "The supposition that excess of uric acid is the cause of gout has now been practically abandoned. It is the opinion of the majority of writers that urates are only by-products of an abnormality of metabolism depending on other causes. This alteration is of some specific nature, as the manifestations of gout point to our having to do with a very definite disease, well marked off from other conditions." "Although we look upon urates as only by-products in gout, their further investigation may teach us how to rid the system of a substance which tends to get deposited in various parts of the body." "It is now accepted by the majority of observers, that it is more than probable that gastrointestinal derangements result in the formation of toxins which, acting chiefly on the liver, give rise to those changes in body metabolism which we recognize as gout. It is an open question to what extent the kidneys are involved in the earlier stages of gout. It is quite probable that the retention of products within the system is due to new chemical compounds with which the normal kidney is not fitted to deal.

Treatment, founded on the combination of massage, exercises, radiant heat and electricity, will usually greatly improve those cases of a more or less chronic nature in three or four weeks.—*A. Mackenzie Forbes, Montreal, Canada.*

Ueber Spatrachitis und die Beziehungen Zwischen Rachitis und Osteomalacie. By Dr. E. Looser. *Mitteilungen aus der Grenzgebieten der Medizin und Chirurgie*, Band XV, III, Heft 4.

The subject which furnished Looser material for his investigations was obtained from the amputated lower extremity of an idiot sixteen years of age, the members of whose family were healthy. The boy had been the subject of many fractures. The fractured bones however united readily. The

tibia were sable-sheath like, and curved with the convexity forward. There was marked thickening of the epiphyses at the wrist. Macroscopic section of the tibia and fibula showed a high-grade atrophy of the corticalis and spongiosa and in place of the epiphyseal cartilage, compact tumor-like growths of cartilage exist. These are seen to arise from overgrowth and folding of the epiphyseal cartilage; signs of endochondral bone formation are found in these growths.

The cartilage calcification zone is very slight.

The primary medullary spaces are very wide, but project neither irregularly nor deeply into the cartilage. The newly built bone trabeculæ are sparely present, mostly calcified, and build with the trabeculæ formed from the medulla, a loose spongy net-work. Osteoblasts are present in large numbers. Osteoclasts are normal in number.

The periosteal bone is very thin and porous. The lacunar resorption surfaces and osteoclasts are in comparison with the normal not increased. The medulla is fibrous.

He considers the case as one of rickets, although clinically and grossly considered, it looked much like osteomalacia.

The differential diagnosis of ostitis fibrosa, osteogenesis imperfecta tarda, hereditary leus and Barlow's disease is considered to exclude them.

He considers late rickets and juvenile osteomalacia as one and the same group, in which the rachitic cartilage changes are always present, and in which atrophy of the bones is a prominent symptom. He recognizes a retrogressive and reparatory process equally active in both diseases.

Rickets and osteomalacia are, however, not considered identical affections, as affecting the skeleton in every period of life, but are met rather in the first period, and in a certain grade, in the second period of the most active bone growth and their clinical and anatomical appearances are modified by the different physiological conditions of the individual life periods.

VI. BONE AND JOINT TUMORS, BENIGN AND MALIGNANT EXOSTOSES, ETC.

Atypische Knieresektion wegen Sarkoms des Tibiakopfes. Allessandri. IV. Kongress der italienischen Gesellschaft für Orthopädie zu Bologna, 15 Oktober 1907.

Lipoma del cavo della mano. Bruchi. Gazetta degli ospedali e delle cliniche, 1907, Nr. 108.

Lipoma Arborescens of the Knee-joint. R. O. Meisenbach. Buffalo Med. Journal, March, 1908.

Fibrosarcoma of Ilium with Metastases in Skeleton. K. Nunokawa. Berliner klin. Woch., May 18, 1908, XLV, No. 20.

Multiple Exostoses in a Rachitic Subject. A. Young. Glasgow Med. Journal, March, 1908.

Zwei Fälle von Knochencysten. Rumpel. Berliner med. Gesellschaft, 17 Juli 1907.

Round-celled Sarcoma of the Dorsal Spine. V. P. Gibney and W. B. Coley. Transactions of the New York Surgical Society, January 22, 1908.

Sopra due casi di paraplegia consecutivi al trattamento röntgenterapico di tumori maligni. Martini. R. Accademia med. di Torino, 14 Febbr. 1907.

Bone Sarcoma. By William B. Coly, M. D., New York. *Surgery, Gynecology and Obstetrics.* February, 1908.

Sarcoma of bones forms a large part of the total number of cases, and the bones most often affected are those which are most often the seat of external injuries.

In making a diagnosis the author feels that the clinical history is of the

utmost importance. Tuberculosis is the disease that most closely resembles sarcoma, but in sarcoma the growth is more rapid and the joints are rarely involved; there is nothing characteristic in the blood. It is wise to have an X-ray, but it may not be definite.

It is much easier to differentiate this disease from syphilis than from tuberculosis.

The prognosis in sarcoma is very grave, and most surgeons advise amputation; but even with amputation the disease is very apt to return, and then life as well as limb is lost.

The author believes that a preliminary use of the mixed toxins should be tried before amputation or excision is done, say for two or three weeks.

There are thirteen cases on record where the limb as well as the life has been saved by this means.

Then, if necessary, amputation, followed by a prolonged use of the toxins as soon as possible after recovery from operation.

Very small doses are given at first and away from the site of the tumor; after a few days the injections are given directly into the tumor.

It is best to produce a severe reaction, as is shown by a temperature of 102 to 105; the action of the toxins is both local and systemic.—*Edward S. Hatch, New Orleans, La.*

VII. SCOLIOSIS AND STATIC DISTURBANCES.

Position of the Sternum in Scoliosis. Report of Progress in Orthopedic Surgery. E. H. Bradford. Boston Med. and Surg. Jour., Feb. 20, 1908, page 257.

The Mechanics of Lateral Curvature. Henry O. Feiss. Am. Jour. of Orth. Surg., July, 1906.

Flat-foot. By Kofman. *Arch für Orthopedie*, Bd. VI Heft 2–3.

The treatment of severer cases should consist of forcible overcorrection and tenotomy of the tendo Achillis followed by fixation for 3 weeks. This is to be followed by the shortening of the tibial muscles and a lengthening of the peronei and pronators.—*Walter G. Stern, Cleveland, O.*

The Surgical Treatment of Bunions. By Charles H. Mayo, M. D., Rochester, Minn. *Annals of Surgery*, August, 1908.

The writer preserves the bursa which is turned in to make a new joint after the head of the metatarsal bone has been removed.—*R. R. Fitch, Rochester, N. Y.*

Orthopedic Heresies on Feet and Their Treatment. By L. R. G Crandon. *Boston Med. and Surg. Journal*, April 23, 1908.

An attack upon the use of plates, pads and wedged heels in the treatment of flat-foot and weak-foot. The ordinary ready-made shoes are very properly criticized. The author then states that the reasons why some patients get well by the use of plates are: (1) "Those who get well after the use of such plates do so because the cause of the collapsing foot was temporary and has disappeared;" (2) "because the feet work so hard to get away from the plates that they develop muscular power and strengthen ligaments;" (3) "some cases may develop into a fixed conventional type of walking and adapt themselves to fixed attitudes; the foot at each step hurdles the plate in hock, arch and hoof fashion."

The making of casts as a guide to the manufacture of plates is stated to be of value only for the purpose of impressing the patient. The use of pads to relieve symptoms caused by weakness of the anterior arch (Morton's metatarsalgia) is entirely irrational. A series of cases is cited to show the

absolute failure of ordinary orthopedic measures, and the immediate and complete success obtained by the use of a shoe light in weight, soft and flexible, with the heel rendered "balancing and unstable" by having the outer front corner made of soft rubber, after the fashion and patent of Small. The reviewer has been informed that Small is a Boston shoemaker. The arguments in the article are in the main illogical and unsupported by common experience, and are presented in the sensational manner of a patent-medicine advertisement.—*Edwin W. Ryeron, Chicago, Ill.*

Scoliosis of Tuberculous Origin. By Charles (Lyon). *Lyon Médical*, 1907.

Poncet means hypothetically that the so-called habitual deformities (lateral curvatures) may not be connected with any form of late rachitis, but may be produced by an infectious disease of bones, in most cases a mild tuberculosis. Ch. describes two observations: In youth, kyphoscoliosis,; later multiple tuberculosis of internal organs (pleuræ, peritoneum, lungs) and joints.

The hypothesis and the attempt to support it seem to be very doubtful.—*H. Bucholc, Boston, Mass.*

Scoliosis Lumbagica. By V. Hovorka. *Arch. für Orthopedie*, Bd. VI, H. 2–3.

Report of two cases of scoliosis due to trauma and rheumatism of the lumbar muscles. The scoliosis is a reflex one and was cured by hydro- and mechanotherapy.—*Walter G. Stern, Cleveland, O.*

Hysterical Scoliosis. By Strauss. *Arch. für Orthopedie*, Bd. VI, H. 2-3.

The author makes the following subdivisions:

1. Pseudo pelvic-scoliosis.
2. Hysterical hip.
3. Isolated simple scoliotic deviation.
4. Compound scolio-kyphotic deviation. The first two groups are caused by abnormal position of the pelvis. The last two are essential spinal hysteria.—*Walter G. Stern, Cleveland, O.*

VIII. CONGENITAL DEFECTS, INCLUDING CONGENITAL DISLOCATIONS.

Ueber zwei Fälle von typischer Extremitätenmissbildung (Ulnadefekt, Fibuladefekt). Eduard Schenck. Frankfurter Zeitschr. f. Pathologie, 1 Bd., 3 u. 4 Heft, 1908, page 545.

Ein Fall von kongenitaler Luxation des Humerus. P. Zander. Ztschr. f. orth. Chir., XX Bd., 1908, p. 237.

Kongenitale Radiusfraktur. Frank. Aerztlicher Verein in Hamburg, 10. Dez. 1907.

Congenital Deformity of Hand and Feet. Willy Meyer. Transactions of N. Y. Surgical Society, Jan. 22, 1908.

Madelung's Deformity of the Hands. William B. Brinsmade. Transactions of N. Y. Surgical Society, Jan. 22, 1908.

Hallux Varus congénital du côté gauche. E. Kirmisson. Revue d'Orthopédie, 1er Mai 1908, IX, No. 3, p. 249.

A Case of Congenital Rotation Dislocation of Both Knees. C. Helling. Berliner klin. Woch., Feb. 3, 1908, No. 5.

Congenital Dislocation of the Hip. Report of Progress in Orthopedic Surgery. E. H. Bradford. Boston Med. and Surg. Journal, Feb. 20, 1908, page 258.

Another Case of Elevation of the Scapula. (Sprengel's Deformity.) Sipari. Proceedings of 4th Congress of Italian Orthopedic Society, October, 1907.

The Treatment of Congenital Dislocation of the Hip by Manual Reduction. By M. Derscheid-Delcourt.

The X-ray has been of great aid by telling when the hip is in. There are but few irriducible cases where the capsule or socket are deformed or the child too old—that is over 10 to 12 years.

He has three radiographs of the case—one before treatment, one three to six weeks after operation and while it is still in external rotation, facing into the cavity. A third when the last plaster is taken off.

The treatment is in three steps, the head is brought down opposite the socket, the femur in abduction and external rotation. The child is fixed in recumbency through two to six weeks.

Second step: the leg is put in internal rotation and abduction, forced, with the leg extended. The child still in bed during three to four months.

Third step, the leg is brought slowly into its normal position, the child is allowed to walk in its plaster, supported by a walking stool, for 2 months.

No preliminary stretching. Kneads the adductors and hammers them a little and pulls with silk girts.

Gives a second anesthetic when going to step two, for the articulation is tender and the child when frightened may throw the hip out. But later, for the repeated dressings, when bringing the leg down, no anesthetic is necessary. There are but two assistants needed—one to chloroform or etherize, one to manage the leg. No traction or countertraction is needed. The difficulty lies in internal rotation, without allowing the hip to slip out. It is usually easy, and then the plaster is applied, embracing the whole body and the foot. The toes should point toward the middle line, and in certain cases where the neck is anteverted the toes should point backward.

After about six months, the bandage is cut away from the foot first, then the knee, which is bent slowly. When the child first walks the leg is thrown out. Exercises and massage are given to bring it back.

The Etiology of Congenital Elevation of the Scapula. By Graetzer. *Arch f. Orthopedie* Bd. VI, H. 2–3

Graetzer reports a case of congenital elevation of the scapula accompanied by numerous other congenital defects such as wry-neck and defects of the muscles, ribs and vertebræ. He deduces from this case that congenital elevation of the scapula is a deformity originating in a "Germ" defect.—*Walter G. Stern, Cleveland, O.*

The Correction and Treatment of Congenital Club-foot; A Reply to Both Lange and Schultze. By Becker. *Arch. für Orthopedie* Bd. IV, Heft 4.

Although the fundamental principals of a bloodless redressment with fixation in the overcorrected position until the foot is cured, has been accepted by the majority of orthopedic surgeons as the treatment for club-foot still the therapeutic principals and technical details of many surgeons are still widely at variance.

According to Becker's views it is a mistake to begin the treatment before the child is at least one year old, because

1. Before this it is often more difficult to correct the deformity.
2. It is often impossible to keep on a plaster cast.
3. If the early operation should fail to cure, then the later operations become exceedingly difficult and almost impossible.
4. There is really no upper age limit to the operation.

The foot must always be thoroughly overcorrected; mild cases over König's wedge and more severe ones in an osteoclast which (like Hoffa's) must be provided with a strong "Pelotte" to tightly fix the heel. Wherever a tendon such as the abductor hallucis or the fascia becomes tense and resists correction it should be divided with a sharp tenotome rather than merely overstretched during the operation and then left to exert its pull when the foot is in a cast. These tensely spanning tendons and fasciæ are the usual cause of severe pain. They must always be divided. It is also usually necessary to divide the tendo Achillis. The operation should not be stopped until the foot is soft and the inner border convex. The result of the redressment should not be judged by pressing the sole of the foot against the table to see whether or no it will touch the flat surface, but it should be judged only by the appearance of the sole and inner border when the foot swings free. He condemns Lange's photographs for violating this rule.

The cast should never be applied in the position of maximal overcorrection, for every foot will tend to spring back from this position no matter how well it has been freed, and pain and decubitus will result; but rather the foot is to be fixed in about three-fourth of its maximal overcorrection and the maximum only reached at a second sitting. Becker advises "never to use any form of padding" to protect the skin from the cast and contents himself with covering the foot and leg with a stockingette tube which has been well impregnated with Lassar's new paste and applies the plaster directly upon this, only placing a small thin strip of tough white felt over the heel, malleoli and inner border of great toe. The foot should not be overcorrected at the end when the finished cast is setting but rather as each turn of the bandage is being put on.

Becker gets rid of the redundancy of the skin over the dorsum which may become folded and give trouble in the overcorrection by gathering it together in an especially devised Péan forceps and then excising an oval or eliptical piece with a pair of scissors and sewing the edges.

If severe traumatic oedema occurs the cast is to be cut open and the foot bathed and massaged and the cast reapplied as soon as possible.

The cast should remain on from two to three months, fear of muscle atrophy which can be cured by use and the proper after-treatment must not deter one from allowing the cast to remain on long enough. Relapse is to be prevented by using a brace night and day or if this is not possible a brace by night and a special shoe by day.—*Walter G. Stern, Cleveland, O.*

The Treatment of Club-foot. A Continuation of the Controversy Between Schultze and Lange. By Schultze. *Arch. f. Orthopedie*, Bd. VI, H. 4.

If the foot has been thoroughly overcorrected and held so far the appropriate length of time, after-treatment with splints is unnecessary. The treatment of club-foot must be begun as early as possible, the only exception being where the physical condition of the child will not allow it. Care in keeping the child clean, protecting the cast with rubber or oil tissue will prevent eczema, etc. A large number of anesthetizations will be unnecessary; casts can be changed and further correction obtained without an anesthetic provided the first correction has been thoroughly performed. The children do not need to be kept in the hospital during the entire course of treatment and can be sent to their homes a few days after the application of the cast. Of course the long fixation causes some muscle atrophy but this is of no great importance as it will disappear as soon as the child begins to use the corrected foot.

Tenotomy of the tendo Achillis should never precede but should always follow thorough mobilization and overcorrection and never interferes with the application of appropriate casts.

The orthopedic surgeon must get as far away from the purely mechanical treatment by means of braces, splints and shoes as possible.

Older children and adults present a much more difficult problem but the treatment can be made successful if performed along the same lines as the early cases. In all cases the correction can best be obtained through the use of Schultze's special hinge osteoclast.—*Walter G. Stern, Cleveland, O.*

The Treatment of Club-foot. A Reply to Schultze's Earlier Arguments. By Lange. *Arch. f. Orthopedie,* Bd. VI, H. 2–3.

Lange divides the treatment strictly into 1. Treatment in earliest life 2. Treatment in older children and adults. In earliest life a club-foot can be corrected manually, over a König's wedge or with the aid of an osteoclast preferably the fixing part of a Lorenz osteoclast of which Lange has designed an especially simple and cheap model. The reduced foot must be made "as soft as butter" and fixed in a plaster cast in overcorrection. After this Lange departs from the usual practice. On the third day in each and every case he takes off the cast and applies a removable splint which he makes out of celluloid using a cast of the corrected foot as a model. The reason for this is that Lange seems to fear that a "Decubitus" is bound to take place in each and every case once the magic 48 hours have passed; he also claims that eczema is the inevitable result of a 2–3 weeks, fixation in a plaster cast; another reason, Lange fears a hopeless atrophy of the muscles from the application of the cast. Other drawbacks to the use of plaster fixation as claimed by Lange, are unnecessary number of anesthetics, necessity of child staying in hospital for entire course of treatment (depending of course on disadvantages already mentioned) and unnecessary delay and expense for parents who stay with child.

Lange fastens his celluloid splints to the foot by means of two long strips of adhesive plaster 3 inches wide. The advantages claimed by Lange for the use of his splint are:

1. It corrects the club-foot as perfectly as does plaster of Paris. 2. Prevents decubitus. 3. Does not irritate the skin. 4. Is simple to make and can be taken off and reapplied to the foot by the parents. This however hardly agrees with the following literal description of Lange's method of using the splint.

The splint is made of reinforced celluloid shaped over a model of the overcorrected foot which latter is presumably made at the time of operation. It is padded and fastened to the foot by means of adhesive plaster on the third day after the operation. It is to be kept on the foot day and night for a period of two hours daily when it is to be taken off and the foot is to be massaged by a nurse; any eczema (1) is to be treated with a bismuth powder or Lassar's paste; the foot is then to be vigorously overcorrected by the physician who is to use the flat of his hand against the sole of the child's foot using his free hand to hold the malleoli firmly and thus avoid the danger of fracturing the tibia or fibula, and finally the splint is to be reapplied.

This treatment is to be kept up until the child is ready to walk when a sort of celluloid steel brace is to be applied. A tenotomy of the tendo Achillis had best be performed in most cases. It is both unnecessary and prevents the proper application of the plaster both for making the model and for fixation. Lange also gives a few of the disadvantages of his splint treatment which the reader can easily increase for himself and which Schultze and others have

used to readily defeat Lange's arguments. Lange gives a number of photographs to show the results of his treatment. They are not very convincing as they only show the position of the feet when bearing weight, this is taken advantage of by Becker (see abstract).

2. In older children and adults the difficulty of treatment is enormously increased and an osteoclast must be used. Serious necrosis of skin, fascia, tendons, etc., and even death has followed the overcorrection of such deformities. Lange does not explain why it is unecessary to thus fully overcorrect these deformities at one sitting. He deduces from his imperfect results in older cases that the treatment of club-foot should be begun as early as possible.—*Walter G. Stern, Cleveland, O.*

The Treatment of Club-foot; Being the Close of the Controversy. By Lange. *Arch f. Orthopedie*, Bd. VI, H. 4.

Schultze is wrong when he says that after manual redressment and a short fixation in plaster no after-treatment is at all necessary.

The plantar flexion-adduction in a case of club-foot must always be converted into a dorsal flexion and abduction, and such an osteoclast as Schultze describes (hinge osteoclast) will not do the work.—*Walter G. Stern, Cleveland, Ohio.*

Congenital Defect of the Ulna. By Francis Denison Patterson, M. D., of Philadelphia. *Annals of Surgery*, August, 1908.

Report of such a case with a photograph and radiographs. The patient also had multiple exostoses of the long bones.—*R. R. Fitch, Rochester, N. Y.*

Cervical Rib and Trauma. By Frank. *Deutsche med. Wochenschr.*, 1908, 14.

Report of a case of an eighteen-year-old patient who was not acquainted with the anomaly in her case until after an accident, following which the symptoms were so marked that the rib had to be extirpated.—*Henry O. Feiss, Cleveland, Ohio.*

A Report of Thirty-one Cases of Congenital Dislocation of the Hip-joint Reduced by Manipulation. By Edville Gerhardt Abbott, Portland, Maine. *Medical Record*, May 23, 1908.

The ages of the patients varied from two to thirteen years, and, as usual, the greater number were females. Twenty-nine cases were unilateral and two were bilateral. The operation performed was the same as that described by Lorenz, with the exception that, in some instances, the plaster-of-Paris spica was extended below the knee in order to better control the after-position of the limb.

In three cases weight traction was used preliminary to the reduction.

Dr. Abbott gives a short history of each case. He found it quite necessary to make firm pressure just behind the trochanter major while the plaster was still soft, so as to mould the plaster to prevent the head of the bone from slipping backward.

The danger of a recurrance of the dislocation through rotation of the thigh bone can be removed, he states, by extending the spica below the knee.

The use of skiagrams he finds to be misleading. The following is a summary of results:

If the two bilateral dislocations are considered as four unilateral, the results may be summed up as follows: No. of hips 33; 22, or 66 percent, normal; 9, or 27 percent, ant. positions; 2, or 6 percent, complete failures.—*John Dunlop, Washington, D. C.*

Remarks upon the Treatment of Congenital and Pathological Dislocation of the Hips. By Mencière. *Arch. für Orthopedie*, Bd. VI, H. 4, P. 374.

Mencière recommends the use of a lever which is to be fastened to the thigh and uses the greater trochanter as the part to receive the force of the leverage. There is no danger of injuring the neck of the femur because no force is applied to it. Mencière claims that this method can be used in older patients without the slightest danger.

With this lever he would also reduce pathological dislocations resulting from a previous tubercular or other coxitis.

Throughout the entire paper the author repeatidly makes the claim that his method of using the lever is harmless. He also insists upon postoperative mechanical and gymnastic treatment and demonstrates a number of machines built after the principles of the Zander apparatus for this purpose.—*Walter G. Stern, Cleveland, Ohio.*

An Original Method of Operating for Congenital Dislocation of the Hip. By Russell A. Hibbs, M. D., of New York. *New York Medical Journal.* April 25, 1908.

Instead of stretching or tearing resisting tissues before attempting to reduce a hip, the author has devised a machine by which he forces the head of the femur into the acetabulum without previous manipulation. The steps of the operation are as follows: Pelvis is fixed by means of author's table; leg is flexed on abdomen; leg is extended on thigh, the latter being held in adduction and flexion on the abdomen, which forces the head of femur below the acetabulum. A special trochanteric pad, which directs the head upward and forward, is firmly applied by wheel and worm-screw mechanism. The thigh is then extended and abducted, forcing the head into the acetabulum, via the anterior route. Plaster is applied with the thigh in abduction and flexion, so as to put considerable tension on the muscles. The plaster runs below the knee which is extended to keep the hamstrings tense. The plaster is changed every two weeks, and the leg brought nearer to the normal position each time. Plaster is continued for only two or three months.—*R. R. Fitch, Rochester. N. Y.*

The Treatment of Club-foot. By Lange. *Arch. f. Orthop.*, Bd. VI, H. 2 and 3.

Lange closes the entire argument in his controversy between himself and Schultz by restating the propositions he laid down in the Münch. med. Wchn. He divides the treatment of club-foot into—

A. Treatment of children in the first year.

B. Treatment of club-foot in older children and adults.

A. In these cases Lange advises only the modeling redressment of Lorenz. It can be done by the hands alone, over a König's wedge or with the help of an osteoclast. Lange prefers the latter and uses for his purpose the fixing part of a Lorenz osteoclast. The use of the osteoclast precludes all danger of fracturing the bones of the leg, without sacrificing any of the force necessary for the correction of the foot. The correction should be carried out until the foot is "soft as butter."

After two days Lange takes off the original plaster cast and uses a removable padded splint to hold the foot in correction. The splint is made of celluloid reinforced with wire netting and is cut out over the malleoli, etc., wherever pressure may come. It is made in two pieces which are fastened to

the foot with adhesive plaster and straps. The splints are to be worn night and day, but are to be taken off twice daily and the foot massaged and overcorrected, after which the splints are to be reapplied. Any eczema is to be treated with bismuth powder.

The reason for the above procedure, which is Lange's sole claim for originality, is that Lange fears a decubitus from the plaster cast and makes a claim that this complication is so frequent that it is absolutely necessary to avoid the continuous fixation in overcorrection in a plaster cast—the common practice to-day. Then, too, eczema is said by Lange to be the usual consequence of the use of a plaster cast (although he confesses that it is also a consequence of his splint technic). Other bad features of a "plaster" technic are—

3. The children are under medical supervision too long. When one uses "plaster" the parents must stay in the clinic with their child for at least 6 months or they must present the child for inspection at least every two weeks. This is usually too costly and also too dangerous for the patient.

4. After one has cured the club-foot with "plaster," a battle must be begun with a severe and long-continuing muscle atrophy.

The splints should have the following characteristics:

1. They must fix the foot as perfectly as plaster."

2. They must not irritate the skin.

3. They must be so simple that the physician himself should be able to make them without the aid of the bracemaker.

4. They must permit the parents to remove them at will for the purpose of massage and passive motion.

This splint treatment is to be carried out until the child begins to attempt to walk, after which the child either gets an insole or a corrective brace, according to the tendency of the foot toward adduction.

Lange rarely performs a tenotomy of the tendo Achillis.

As he does not speak of more than one reduction, the reviewer so interprets the article to mean that the entire correction is carried out at the first sitting. The photographs used to prove Lange's contentions are ill chosen, as they only show the position of the foot while it is bearing weight and not the outline of the sole while hanging free.

B. Club-foot in older children and adults is to be treated by a reduction of the deformity in an osteoclast and fixation in "plaster" for from six to eight weeks. This to be followed by a "night splint." These operations are often exceedingly difficult and dangerous and may lead to the severest necroses of the bones and tendons, and death may even be a consequence.

Lange urges the profession to begin the treatment as soon after the birth of the child as possible.—*Walter G. Stern, Cleveland, O.*

The Etiology of Congenital Elevation of the Scapula. By Graetzer. Reviewed in *Arch. f. Orthop.*, Bd. VI, H. 2–3, p. 266.

This case of congenital elevation of the scapula was part of a general malformation due to amniotic causes. There were present in this patient congenital wry-neck, muscle defects, defects of the ribs and vertebræ and deviations of the cervical vertebræ.—*Walter G. Stern, Cleveland, O.*

Concerning the Mechanical Reduction of Congenital and Pathological Dislocations of the Hip. By Mencière. Reviewed in *Arch. f. Orthop.*, Bd VI, H. 4, p. 374.

Mencière recommends in older patients the use of his reduction lever which he invented and described in 1903. It works directly upon the trochanter, thus avoiding the danger of producing a fracture of the neck of the

femur, since no force at all falls upon this structure. He describes the mechanics of the lever and cites a number of cases in which he safely used it; the oldest patient being nine years old.

As further proof of its harmlessness he cites the reduction of a hip dislocated from a previous tubercular coxitis which was accomplished without any untoward results.

The need and importance of postoperative mechanical and gymnastic measures, especially in older patients to avoid ankylosis, is taken up. Most of the apparatus is based upon machines of Zaner and Krakenberg.—*Walter G. Stern, Cleveland, O.*

IX. APPARATUS AND X-RAY.

Klumpfuss-Redresseur nach Dr. Cramer-Köln. Heinrich Landwehr. Zentralbl. f. chir. u. mech. Orthopädie, Mai, 1908, p. 197.

Splint for Holding Club-foot in Position After Operation. E. G. Abbott. Lancet-Clinic, June 6, 1908.

Portable Apparatus for Extension and Fixation While Applying Plaster-of-Paris Dressings. E. L. Sanderson. Journal A. M. A., May 9, 1908, p. 1522.

A Roentgenologic Discussion of Bone Lesions. E. H. Skinner. Interstate Med. Journal, St. Louis, May, 1908.

Schutz des Arztes und des Patienten gegen Schädigung durch Röntgen- und Radiumstrahlen. Dessauer. Münchener med. Woch., 1907, 37

Pendulum Apparatus and an Apparatus for Rotary Correction in Curvature of the Spine. Robert Soutter. Boston Med. and Surg. Journal, Feb. 20, 1908, page 243.

Apparat für die Behandlung der schrägen oder complicierten Fracturen des Beines. E. Martini. Archiv f. klin. Chir., 1908, LXXXV, No. 3.

Machine for Forcible Correction of Deformed Feet. J. A. Nutter. Montreal Med. Journal, February, 1908.

Spezieller Plattfussstiefel. C. Lengfellner. Deutsche med. Woch., May 28, 1908, XXXIV, No. 22.

Bewegungsapparat für das Kniegelenk. A. Haslebacher. Correspondenzblatt für schweizer Aerzte, Basle, April 1, 1908, XXXVIII, No. 7.

X. TRAUMATIC LESIONS. FRACTURES AND DISLOCATIONS. SPRAINS.

Fracture of the Surgical Neck of the Femur, with Inversion of the Limb. J. D. Bryant. Surgery, Gynecology and Obstetrics, February, 1908.

Spontaneous Separation of the Upsilon-shaped Cartilaginous Suture of the Acetabulum. P. Frangenheim. Archiv f. klin. Chir., Band LXXXIII, Heft 1, 1908.

Ein Fall von traumatischer Verrenkung des Fusses nach hinten. A. Wertheim. Deutsche Ztschr. f. Chir., Bd. XCI, Heft 1–2, 186.

The Treatment of Fractures of the Upper and Lower Ends of the Femur by Extension. Bardenheuer. Archiv. f. klin. Chir., Band LXXXIII, Heft 1, 1908.

Forward Dislocation of the Knee. Howard A. Lothrop. Boston Med. and Surg. Journal, March 5, 1908, page 324.

Typische Verletzung am unteren Femurende. A. Stieda. Archiv f. klin. Chir., LXXXV, 1908, No. 3.

Un caso di lussazione traumatica della cartilagine semilunare esterna dell' articolazione del ginocchio. P. Bizziocchi. Gazetta degli Ospedali e delle cliniche, 1907, 39.

Die Elfenbeinstifte bei der Behandlung von Frakturen und Pseudarthrosen und als osteoplastischer Ersatz. Bircher. Fortschritte a. d. Gebiete der Röntgenstrahlen, XI, 5.

Luxatio ossis Lunati. Kr. Poulsen. Archiv f. klin. Chir., Bd. LXXXIII, Heft 3, p. 801.

Baseball Fingers. Hall and Stover. Archives of the Röentgen Ray, Nr. 84, July, 1907.

Arrest of Growth at the Lower End of the Radius After Separation of its Epiphysis. Adolph Waechter. Annals of Surgery, July, 1908, p. 115.

Zwei Fälle von bisher nicht beobachteter Sehnenluxation. Schlesinger. Berliner klin. Wochenschr., 45, 1907.

The Bennett Fracture of the First Metacarpal Bone. Diagnosis and Treatment. Samuel Robinson. Boston Med. and Surg. Journal, Feb. 27, 1908, page 275.

Separation of Upper Epiphysis of Humerus. Royal Whitman. Transactions of New York Surgical Society, Jan. 8, 1908.

Traumatic Subluxation of the Humerus. Frank P. Vale. Annals of Surgery, May, 1908, page 709.

Nine Cases of Fracture of the Carpal Scaphoid. L. W. Ely. Medical Record, New York, May 9, 1908.

Coxa Valga: Ununited Fracture of the Femoral Neck; Report of Two Cases. N. Allison. Interstate Med. Journal, St. Louis, April, 1908.

Spontaneous Fractures in Children. G. Hunaeus. Deutsche med. Woch., March 26, 1908, XXXIV, No. 13.

Treatment of Sprains. T. Toepel. Atlanta Journal-Record of Medicine, May, 1908.

Anterior Dislocation of the Sternal Ends of the Clavicles; Treatment by Fracture of the Clavicles with Good Results. T. H. Middlebro. Lancet, London, April 18, 1908.

Isolated Fracture of the Transverse Processes of the Spine in the Lumbar Region. Ehrlich. Deutsche Zeitschr. f. Chir., Leipsic, March, 1908, XCII, Nos. 4–6.

Colles' Fracture, with a New Theory of Its Mechanism. Leonard W. Ely. Journal A. M. A., June 27, 1908, page 2130.

Case of Forward Dislocation of the Humeral Head Irreducible by Manipulation. Reduced by Open Operation. F. W. Parham. New Orleans Med. and Surg. Journal, March, 1908.

Operative Treatment of Old Fracture of the Patella. J. Rotter. Deutsche med. Woch., April 23, 1908, XXXIV, No. 17.

Treatment of Fractures of the Patella of Long Standing. Lord Lister. Lancet, London; British Med. Journal, April 11, 1908.

Treatment of Fracture of Femur in Newborn. R. Jones. British Med. Journal, June 6, 1908.

Spinal Sprain. Its Complications and Consequences, with reports of Cases. By Prescott Le Breton, M. D. *Journal A. M. A.*, May 23, 1908, p. 1679.

Makes three classes: (1) sprain, (2) sprain followed by neurotic symptoms and (3) sprain accompanied by spinal-cord symptoms. Does nos include sacro-iliac lesions, neurasthenic spine, spondylolisthesis or mild traumatic lumbago.

Causes.—Indirect injury, seventeen out of twenty-six cases. Nine cases direct. More often at dorso-lumbar junction (nineteen lumbar, seven sacral). In Bauch's series of forty-three cases, thirty-eight were lumbar.

Pathology.—Ligaments about the spinal column are torn with a laceration of muscle and fibrous tissue. Smaller joints involved, ribs to spine. Concussion and pressure symptoms from nervous system.

Symptomatology.—Sprain (Class 1), Patient does not regard himself as hurt at first. Increasing symptoms. Backache about spine radiating down hips. Rest relieved, rising from chair increases. Muscle groups stand out in muscular spasm. May get knee jerk, and ankle-clonus.

Sprain followed by neurotic symptoms (Class 2) milder injury, backache, tenderness, pain on motion, muscular weakness, tremor, and knee-jerk. Romberg pulse and sweating. Hysterical symptoms.

Sprain accompanied by spinal-cord symptoms (Class 3). After a variable period there is slow or rapid onset of cord signs, pains, anesthesia, partial or complete paralysis, ataxia.

Diagnosis.—History, subjective symptoms considered. Posture, gait and

facial expression. Method of rising. Standing with eyes shut. Contour of spine, Local tenderness. Spinal motions, if limited, due to either pain or spasm. The wry-neck may simulate Pott's disease.

Neurotic cases. The grouping of symptoms must be considered rather than the objective signs.

Prognosis.—Early proper treatment Unwise to defer jacket. Settle law cases as early as may be.

Treatment.—Partial fixation worthless. Neurotic: a light temporary support followed by massage, light exercise and avoidance of jar. Jacket not applied in head suspension but in supine positions as for Pott's disease. If adhesion then manipulate with or without anesthetic. Neurotic cases: spinal douches, ergot, electricity. Cord cases lumbar puncture. Ten illustrative cases.

Treatment of Fractures of the Femur. By Oscar H. Allis, M. D., Philadelphia *Annals of Surgery*, June, 1908.

The author puts a plaster-of-Paris cast on the well leg, and another one on the injured leg below the knee. These casts are allowed to harden, and then the injured leg is put in the proper position and held there by attaching the cast on it to the one on the well leg.—*R. R. Fitch, Rochester, N. Y.*

Arrest of Growth at the Lower End of the Radius after Separation of its Epiphysis. By Adolph Waechter, M. D., of New York, *Annals of Surgery*, July, 1908.

Report of such a case with radiograph. Treatment consisted in the resection of a portion of the ulna to make it a suitable length for the shortened radius.—*R. R. Fitch, Rochester, N. Y.*

Strain-fractures of the Knee. By Sidney Lange, M. D., Cincinnati, O. *Annals of Surgery*, July, 1908.

The writer reports four cases of avulsion of portions of the tibia or femur without the usual signs of fracture. These cases are the result of ligamentous or muscular strain. Such fractures are usually not recognized. An X-ray examination is most important.—*R. R. Fitch. Rochester, N. Y.*

Musculo-spiral Paralysis Due to Dislocations of the Head of the Radius. By De Witt Stetten, M. D., New York. *Annals of Surgery*, August, 1908.

A complete consideration of this subject with a report of a case treated by resection of the head of the radius, which was followed by complete recovery. —*R. R. Fitch, Rochester, N. Y.*

Observations on the Posterior Luxations of the Shoulder together with a Report on all the Cases occurring in the Goettinger Surgical Polyclinic. By Ellerbrock. *Zeitschr. f. Chir.* Bd. 92, Heft 4–6, S. 453.

In the time mentioned in the title, there had been nine such cases observed. With regard to treatment the successful reposition consisted in a gentle pull of the upper arm in the direction of its own axis, thus replacing the head of bone by direct pressure.—*Henry O. Feiss, Cleveland, O.*

Habitual Dislocation of the Shoulder. By Dr. Willy Meyer. *Meeting of the New York Surgical Society*, Feb. 12, 1908.

Dr. Meyer presented a postoperative case of habitual shoulder dislocation following a fall, in a man of thirty-one. He exposed the joint capsule by an

incision between the pectoralis major and the deltoid, together with a lateral incision 1½ inches long through the acromial origin of the deltoid; without entering the joint, he inverted the capsule toward the inner side and stitched it down with a continuous chromicized catgut suture. There had been no recurrence of the dislocation one year and eight months after the operation.—*C. W. Hoyt, Rochester, N. Y.*

Report on the Mechanism and the Consequence of Fractures of the Os Calcis. By Tietze. *Archiv. f. Orthopedie*, Bd. VI, Heft 4.

These are not tearing fractures, but compression fractures, for we must take into consideration not merely the load, but also the resistance of the floor, the joint condition and the direction of the split of the bone. The form of all fractures varies according to the direction of the blow. Statistics given as to results. Of 76 patients, 32 percent had complete function. Method of treatment described.—*Henry O. Feiss, Cleveland, Ohio.*

Traumatic Laceration of Cartilage in the Knee-joint. By Budinger. *Zeitschrift f. Chir.*, Bd. XCII, Heft 4–6, S. 510.

These are frequent injuries of the knee-joint. The favorite place is the patella. Next to that the femoral joint surfaces. Many heal spontaneously. There is some disturbance of function in the joint when cartilaginous projections occur, when the lacerations become general or when the synovial membrane is partially gone. The clinical diagnosis is usually impossible. Arthrotomy is indicated only under certain conditions.—*Henry O. Feiss, Cleveland, Ohio.*

Automobile Fractures. By Deutschländer. *Abstracted in Arch. für Orthopedie.* Bd. VI, H. 2–3.

These fractures, which are caused by premature firing and the forcible reversal of the crank, are, so to speak, reversed Colles' fractures. It is often difficult to differentiate these fractures from true dislocations of the wrist. Removable splints and early massage and passive motion are recommended for the treatment.—*Walter G. Stern, Cleveland, Ohio.*

The Operative Treatment of Recent Fractures of the Femoral Shaft. By Dr. T. W. Huntington. Read before the California State Medical Society, April 22, 1891.

Dr. Huntington makes an earnest plea for operative treatment of these fractures. It is apparent that end results which in former days were satisfactory can to day be shown from an anatomical stand-point to be faulty in the extreme. He confesses that with his very large experience without the X-ray he cannot tell with any degree of accuracy the position and status of fractures—particularly of femoral fractures.

The surgeon is confronted by three exactions, namely, reestablishment of normal relations, maintenance of alignment and accordance of rotation. While he admits that ideal results may be obtained by conservative methods, he firmly holds that in the greater number of instances ideal adjustment is difficult if not impracticable.

He emphasizes that he believes that shortening to an appreciable degree in transverse fractures means overlapping—a condition not to be tolerated. Bardenheuer's plan, he thinks, would not usually be tolerated, and is of the opinion that alignment should be determined through an open incision and the position maintained by mechanical means applied to the bone. He

speaks of Parkhill's clamps or modifications of them, but prefers Lane's staples to all other methods.

Conclusions:

1. The term "satisfactory" is too elastic.
2. The two-plane radiogram affords most reliable diagnosis.
3. Possibility of infection not prohibitive.
4. Operative wounds less susceptible to infection in initiative than in late corrective procedures.
5. Anatomical reposition is essential to quick repair.
6. In oblique fractures slight overriding is permissible.
7. In transverse fractures, shortening is due to overlapping and is incompatible with good surgery.
8. Mechanical traction during operation is indispensable.
9. Steel staples have proven superior to other methods of fixation.—*Dr. Hunkin, San Francisco, Cal.*

Fractures Injuries and Traumatic Diseases of Bones and Joints. A collective abstract for 1906. By Bettman. *Arch. für Orthopedie*, Bd. VI, H. 4.

1. General. Fragenhein has shown that the muscular and other connective tissues take part in the callus formation, thus explaining the not infrequent occurrence of myositis ossificans. Engel collected 100 cases of birth fractures and has shown that they heal readily. F. König declares that radiography has deepened our diagnostic ability, but has not done away with any of the older methods for diagnosis. In the ordinary case the X-ray is unnecessary, in severe cases indispensable. Brum declares radiography in fractures to be no simple affair, often two or more views are necessary in order to come to a complete understanding of the case; fractures can often be overlooked with the ordinary X-ray examination. Many authors claim the best results from a short fixation and the early use of massage, motion, use and the application of Bier's hyperemia. The more complicated fractures are now being treated by the simplest methods of reduction and exact apposition, after thoroughly cleaning the field. As opposed to the exact rules laid down by Bardenheuer, many general surgeons advocate the wiring of all fractures and especially those near a joint. Their results cannot be said to be superior to those of Bardenheuer and his school and the risk to life and limb infinitely greater. The treatment of ununited fractures is still a moot point and Bier's injection of blood-serum is no better than that of the tincture of iodine or any other irritant. The operative methods are still the best.

2. *Special Fractures.—Spine.*—The X-ray has been of great use in the clearing up of the diagnosis in obscure traumatic conditions of the spine. Fractures of the sacrum are often hard to diagnose; the Trendellenburg limp being often a valuable diagnostic sign of this condition.

Humerus.—Isolated fractures of the greater tuberosity is shown by the X-ray to be no longer a surgical curiosity. Nerve complications are still more frequent in fractures of the humerus than in any other part of the body.

Forearm.—A reversed Colles' fracture is caused often by automobile accidents.

Wrist.—Fracture of the scaphoid is one of the numerous fractures shown to be much more frequent than formerly supposed.

Thigh.—Fragenhein claims that the division of these fractures into intra- and extracapsular is not justified by careful X-ray examinations. He divides them into subcapital and basilar fractures of the neck, with complete, incom-

plete or no impaction. Dollinger claims excellent results from the use of ambulatory casts, while the Bardenheuer extension methods are much vaunted.

Patella.—Opinion is still divided as to conservation or operative treatment.

Leg.—The fractures of the upper third of the tibia always give the worst prognosis, of all fractures, as to bony union.

Ankle.—Fractures of the os calcis have been the subject of numerous and long dissertations; they are often hard to diagnose.

Spontaneous fractures are usually caused by some disease of the bones, such as cysts, osteitis deformans, rickets, etc.

Traumatic Bone Disease.—The most important idea advanced is the occurrence of bone tuberculosis after traumata.

For the complete bibliography and details it will be necessary to consult original. It is to be regretted that for Bettman, as well as for most German compilers who have published abstracts in the last few years, the world's literature, of which this collection abstract is supposed to be a review, ends at the German boundaries. English and French literature is sparingly referred to, while from America and Italy scarcely more than a half-dozen publications are referred to.—*Walter G. Stern, Cleveland, Ohio.*

A Clinical Contribution to the Question of the Treatment of Fractures of the Finger. By Kofman. *Arch. für Orthopeaie.* Bd. VI, H. 4.

A laborer must be put into position to resume his occupation as quickly as possible. Time is money, therefore the usual six weeks of immobilization, followed by several weeks of after-treatment for mobilizing stiff and sore joints, must be shortened whenever possible. Fracture of the fingers disables a mechanic immediately; it is often difficult to keep the fragments securely in apposition by the usual extension and fixation methods and they take too long to secure union.

The author proposes to hold the fragments by doubling the hand over a roll of cotton and then holding the fingers securely flexed by means of a compression bandage. Ten days after the injury there will be no tendency toward displacement and the bandages can be taken off, and a course of 3 weeks of massage and exercise completes the cure. In all a loss of only 4 to 5 weeks' time. He gives the credit of priority for this method to Jottkowitz (Centralb. f. chir., Nov., 1905), but seems to be ignorant of the fact that to fix the fingers flexed over a roller bandage, has been a classical method of treating fractures of the fingers in America for decades.—*Walter G. Stern Cleveland, Ohio.*

The Pathological Changes in Old Dislocations of the Elbow, and their Bearing upon the Operative Treatment—Paralysis due to the Elastic Tourniquet. By Alex. R. Colvin, M. D. *The St. Paul Medical Journal*, April, 1908.

The report of a specimen obtained postmortem, where a fracture dislocation had existed for fifteen years, and the report of a case where the dislocation had occurred three months before operation. In both cases, the anterior part of the joint capsule had been converted into a bony plate.

Inasmuch as no such osseous development occurred in the posterior part of the capsule, it is suggested that the functional irritation of attempted movements had stimulated the formation of osseous tissue in the anterior capsule, which was slung tightly around the articular surface of the humerus.

The radiographs show this osseous plate in both specimens very clearly.

This plate would form an almost insurmountable obstacle to nonoperative reduction.

The advantage of the lateral incisons in the operative approach are set forth. Complete motion and sensory paralysis supervening directly upon the operation, is ascribed to the use of the elastic tourniquet. Sensation began to return in forty-eight hours. The first voluntary muscular contractions were observed two and one-half months later.

The Ambulatory Treatment of Fractures as Applied to Osteotomy. By G. Burnside Buchanan. *Practitioner*, April, 1908.

The author enumerates the advantages of the ambulatory treatment in general. The employment of massage to counteract the tendency to muscular atrophy has lead to greater rapidity of healing. The chief disadvantage in massage is that in oblique fractures the fragments are apt to be displaced. Bier has drawn attention to the modes of treating ununited fractures adopted by Thomas many years ago. These consisted of manipulations and percussion with the object of stimulating more active proliferation. Bier maintains that the good effect is largely derived from the influence on the blood-vessels causing more profuse exudation of nutrient and stimulating fluid. It is certain that the ambulatory treatment produces greater active hyperemia and more rapid consolidation of the fractured bone in much the same way as massage.

In ambulatory treatment, as well as in massage, oblique fractures are apt to be displaced, but in transverse fractures, such as is made in a linear osteotomy, the problem is simple.

In 1903 M. Von Brunn reported a long series of cases of osteotomy treated precisely as by MacEwen, with the exception that the limb was immediately encased in plaster of Paris, with the addition of a splint, almost identical to the Thomas' knee-splint. The patient was set up to walk the next day. The writer points to the fact that there is a danger of causing gangrene or ischaemic paralysis by applying an inelastic casting over the surface of the uninjured limb, as the resulting swelling is apt to cause compression of the blood-vessels. The safest way, he points out, is to await the subsidence of the swelling which usually occurs in an osteotomy within four days or so, and then apply plaster of Paris.

The author has adopted the following method:

After correction of the deformity the wound is closed by stitches, and the limb is put in a padded splint in the fully corrected position. In three or four days if the swelling has subsided, the limb, being covered with stockinette, encased in plaster of Paris, from the ankle to the groin. As soon as the plaster is dry, the patient is encouraged to walk.

It is claimed that this method permits of a much shortened stay in hospital. In two cases the patients were discharged in six days. —*A. Mackenzie Forbes, Montreal, Can.*

XI. MISCELLANEOUS DISEASES. GENERAL ORTHOPEDIC ARTICLES. REPORTS OF SOCIETY PROCEEDINGS IN ABSTRACT. PHYSICAL THERAPY, ETC., ETC.

Varietäten des menschlichen Fussskeletts. W. Bocker. Berliner klin. Wochenschr., XLV, No. 10, March 9, 1908.

Behandlung eines Falles von Brandnarben mit Fibrolysin. Hirtler. Med. Klinik, 1907, Nr. 41, page 1234.

Handbuch der Orthopädischen Technik. Schanz. Gustav Fischer, Jena, 1908.

37. Versammlung der deutschen Gesellschaft für Chirurgie, Berlin, 21–24.

April, 1908. Reported in Zentralbl. f. chir. u. mech. Orthopädie, June, 1908, p. 284.

Production of Pseudarthrosis of the Hip Without Disarticulation of the Head. R. Jones. Brit. Med. Journal, Feb. 29, 1908.

Eine ungewöhnliche Form der Knochenerweichung. Joachimsthal. Berliner med. Gesellsch. 23. Oktober 1907. Berliner klin. Wochenschrift. 1907, 45.

Transplantation of Entire Joint in Treatment of Bony Ankylosis of Elbow. P. Buchmann. Zentralbl. f. chir., May 9, 1908, XXXV, No. 19.

Arthroplasty for Ankylosis, with Report of Cases. H. J. Whitacre. Lancet-Clinic, Cincinnati, April 18, 1908.

Sciatica. M. L. Barshinger. Med. Record, New York, April 25, 1908.

Maladies des Os. Mauclaire. Paris, 1908, J. B. Baillières et Fils.

Experimental Research to Explain Action of Constriction Hyperemia. E. von Graff. Münchener med. Wochenschr., Feb. 11, 1908, LV, No. 6.

Modern Orthopedic Surgery. G. G. Davis. Pennsylvania Med. Jour., Feb., 1908.

A Case of Intermittent Limping. Leonard W. Ely. Journal A. M. A., May 2, 1908, page 1423.

Ferments as Intestinal Antiseptics. A. S. Gubb. Clinical Journal, London, Feb. 12, 1908.

The Opsonin Theory and the Probable Future for Bacterial Vaccines. L. H. Warner. Med. Fortnightly, St. Louis, Feb. 10, 1908.

Beiträge zur Immunitätslehre: Ueber Opsonine. Strubell. Münchener med. Woch., 1907, No. 44, p. 2172.

Dental Caries as a Factor in the Etiology of Other Diseases. Lawrence W. Baker. Boston Med. and Surg. Jour., March 26, 1908, page 401.

Orthopedic Surgery as a Specialty. By A. Lorenz. *Wiener med. Wochenschrift*, 1908. Ref. in *Centralblatt für chir. und mech. Orthopädie*, May 1908, p. 204.

L. tries to prove that orthopedic surgery is as distinct a specialty as the other specialties formerly connected with surgery, although the special technic is not so difficult as for instance the different mirror technics in ophthalmology, etc., and its borders are not so distinct.

But on the whole, orthopedic surgery uses other methods than general surgery, the technic is simple; the chief instrument is the hand; other instruments are chisel and tenotome. In the treatment of club- and flat-foot, dislocation of the hip, etc., the best results have been obtained with the hand.

The complicated treatment with apparatus and braces, and the exact technic of bandages will always need very careful study. In scoliosis the pathological anatomy was made clear by orthopedic surgeons, the borders of its curability were perceived and appointed by them. The treatment of fractures and dislocations should belong to orthopedic surgery, in fact the surgery of the mechanism of motions especially the non-bloody part. So separation of single parts of surgery will continue and, finally, the time will come when general surgery, unwillingly and involuntarily however, will sacrifice itself for her children like the Phoenix. Then all her thankful children will exclaim in unison: general surgery is dead, special surgery may live.—*H. Bucholz, Boston, Mass.*

The Occupation of the Chair for Orthopedics in Berlin. By Mamlock. *Deutsche medizinische Wochenschrift*, February 13, 1908.

After the death of Hoffa the medical faculty of the university of Berlin did not wish to have his chair occupied again, chiefly because the number of students working in orthopedic surgery was small. M. says that this statement would be the same for other departments, e. g., the hydrotherapeutic, the Rœntgen department, etc., and he emphasizes the fact that orthopedic sur-

gery demands a special education, that it is difficult to learn it in connection with general surgery. This is acknowledged by the Austrian government and great surgeons as Mikulicz. The same reason was given formerly in regard to Ophthalmology, Urology, etc. But these specialties have gained a good deal by separation, while surgery has not lost any of its power and influence. Another reason for the separation of orthopedics from general surgery is that orthopedics has much to do with the care of cripples and this demands a special training.—*H. Bucholz, Boston, Mass.*

A New Method of Using X-Rays. By Dessauer. *Arch. für Orthopedie*, Bd. VI, H. 2–3.

To reach morbid processes which are especially deep-seated Dressauer hangs a number of very "hard" X-ray tubes suspended from the ceiling at a distance of from 4 to 5 metres above the patient and has the patient pass both day and night in the room exposed to these rays. The selective action of the X-ray upon newly-formed or embryonic tissue is claimed to be greater with this method.—*Walter G. Stern, Cleveland, O.*

The Limitations of Roentgenological Diagnosis. By Zappinger. *Archiv für Orthopedie*, Band VI, H. 2–3.

Tissues of like densities even though they be of pathological nature cannot be differentiated from each other. How much such tissues must differ from each other before they can be told apart depends upon

1. The thickness and size of the objects, tissues or organs.
2. The hardness of the tube.
3. The sensitiveness of the plate.
4. The duration of the exposure.—*Walter G. Stern, Cleveland, O.*

The Use of Bier's Hyperemia in Orthopedic Operations. By Deutschlander. *Arch. für Orthopedie*, Bd. VI, H. 2–3.

Seven days after a subcutaneous or subperiosteal osteotomy D. opens the cast and applies the constricting bandage from 6 to 8 hours daily. All cases were controlled by the X-ray. He believes the deposit of callus and the consolidation of the osteotomy fracture to have been much quickened by this practice.—*Walter G. Stem, Cleveland, O.*

An Improvement in Rœntgentechnic for Use in Difficult Regions. By Köhler. *Arch. für Orthopedie*, Bd. VI, H. 2–3.

Köhler recommends the use of two plates placed face to face instead of the usual method of using one plate with the face upwards. He gives no reason for any advantage, but demonstrates that it is no disadvantage in having the rays pass through a glass plate before reaching the sensitive film.—*Walter G. Stern, Cleveland, O.*

Physical Therapy in Sweden. By Hagbund. *Arch f. Orthopedie*, Bd. VI, H. 4. P. 377.

In the home of Physical Culture and Therapy there is, in the three universities, no chair on this subject and undergraduate students have no means of receiving instruction in these branches. In spite of this neglect this mode of treatment has made great advances in Sweeden because of the precuniary aid given by the State to certain lay institutions and gymnasiums.

Rœntgen and phototherapy (Finsen) are much in use and rightly so, but the high tension and high frequency electrical currents (static, Tesla, Oudin, etc.) are not held in very high esteem.

Balneology, mechanotherapy, massage and orthopedic surgery seem to be

jumbled up under one heading and taught by "Privat-dozenten." The real Swedish Gymnastic Therapeutics was originated by a layman and is practised and taught in a number of central gymnasiums which are not in the hands of medical mean and quackery is rampant especially among the "teachers" going to foreign countries.—*Walter G. Stern, Cleveland, O.*

A Report of the Publications on the Subject of Gymnastics and Massage, 1906. By Bettman. *Arch. für Orthopedie,* Bd. VI, H. 4.

I. Gymastics. Ekgren gives an accurate description of the Swedish system. Hohnan describes methods of treating joint contractures. Bähr describes apparatus for the mobilization of the shoulder.

II. Massage. Bum, of Vienna, has made important contributions on this subject, while Lininger advocates especial methods in the treatment of inflammatory and traumatic joint-disease. For place and dates of various publications it is necessary to consult original report.—*Walter G. Stern, Cleveland, O.*

Orthopedic Technic. By Thilo. *Arch. für. Orthopedie.* Bd. VI, H. 2–3.

The author thus introduces a rather voluminous contribution: "The technic illustrates the use of wire. It gives the physician the possibility of making splints, braces, corsets, etc., with his own hands."

1. Pressure Bandages of Felt can best be used for the immediate treatment of traumæ, sprains, etc.; where the injury has been more severe the felt can be covered and stiffened with tin. The felt bandages or splints are always to be made in two parts and must *not* cover the whole circumference of the limb. Where bony projections are encountered, as the ankle hole should be cut in the felt to accommodate them. Pressure can be applied by means of tight roller or elastic bandages, it can also be done by means of circular turns of adhesive plaster.

2. Adjustable Crutches with Leather Spring Tops. Thilo's model is very crude and heavy and is altogether inferior to the leather spring top crutches obtainable in the open market in America. The same is also true to some extent of his felt splints.

3. Corsets with Wire Inserts.

(a) Plaster corsets with circular wire turns. Each turn begins and ends in a hook which projects through the plaster to either side of the median line and is used for lacing. Perpendicular wires can also be inserted and hooked to carry crutches.

(b) Celluloid corsets. The method of making is poorly described.

(c) Cloth corsets. Hessing model is recommended, using round wires instead of flat steels—"Round system." These corsets can also be made with or without pelvic crutches, axillary crutches or head support.

Sheet Tin Splints. The manufacture and application of these splints to all parts of the body is given in detail. The tin is cut with ordinary tinner's snips after paper models and are so made that the middle and sides are reinforced longitudinally with wire. Few American orthopedists will agree with Thilo's method of treating club-foot, flat foot, pes calcaneous and other rigid deformities with these splints. An excellent apparatus for the prevention and cure of flexion contractures of the hand and fingers is described and could be advantageously combined with Jones' method.

5. Motion.

(a) Passive motion is often used where rest had in former decades been thought necessary, but it should never be forced and never give rise to great pain or muscle contractures.

(b) Resistance exercises and muscle education are of great use:
(1) to improve local and general circulation;
(2) to stretch abnormal tissues and muscles;
(3) to exercise and strengthen weakened muscles;
(4) to decrease abnormal use of muscles.

A large number of ingenious and cheap forms of apparatus are described for the carrying out of such resistance exercises for almost every part of the body. In all over 150 separate pieces of apparatus are illustrated and described.—*Walter G. Stern, Cleveland, Ohio.*

The Relations of the Adductor Muscles. By Roith. *Arch. f. Orthopedie.* Bd. VI, H. 2–3.

These experiments made after the principles laid down by S. Mollière allowed the following deductions.

The adductor Magnus acts as adductor only after the leg has been abducted from the median line. The dorsal third of this muscle is antagonistic to extreme adduction and only the anterior parts of this muscle possess real "adductive components."

Active adduction from the physiological position is accomplished through the adductor longus, brevis and pectineus.

The abductors have little power to overcome an existing adduction, this being usually brought about by the force of gravity. They act entirely from the physiological position.

The psoas cannot act laterally upon the femur when in the physiological position; but if the limb has been either adducted or abducted, then the Psoas can act as abductor or adductor or vice versa.—*Walter G. Stern, Cleveland, Ohio.*

Bier's Hyperemic Treatment. By Gebele. *Münch. med. Woch.*, Jan. 28, 1908, No. 4.

Author gives his results in general terms and concludes as follows: If we look over the very large field where hyperemia is applicable, we may regard it as the most versatile method of treatment that is at our command. It is not a cure-all as Bier represents in his book, yet everyone who wishes to use the method should read his monograph, then he may best grasp the spirit of the work.—*Henry O. Feiss, Cleveland, O.*

The Plaster-of-Paris Bar or Rope. By Robert Soutter. *Boston Medical and Surgical Journal*, Apr. 30, 1908.

To combine lightness with strength in plaster-work, Soutter suggests a simple expedient. After a few layers of plaster have been applied, a short bar or rope is made by unrolling a wet plaster bandage and rapidly folding it back and forth upon itself six or eight times. This need not be twisted into a rope, but is simply pressed into the shape of a rope by pulling it through the partly closed hand. It is then laid where most needed, as over the groin in spicas, and covered with a few turns of bandage.

It is more rapid and effective than the ordinary reverses made upon the cast itself.

The Significance of the Adductors of the Hip-joint in their Relation to the Other Muscles Acting on this Joint. By Roith. *Archiv. f. Orthopedie, Mechanotherapie u. Unfallchirurgie*, VI, 2–3.

The size of the adductor group signifies that these muscles have a large mechanical task and that this must either be something more than mere adduction or adduction inside of the vertical must occur oftener than is

usually supposed. In favor of the first supposition, he refers to the pain in the adductors following flexion movements, as in mountain climbing. Further, the innervation of the adductors favors this supposition.—*Henry O. Feiss, Cleveland, Ohio.*

The Snapping Hip. By Brunn. *Beitr. z. klin. Chir.*, Bd. LVIII, Heft 1, S. 121.

Author refers to a case of a girl 15 years old who developed trouble in the left hip-joint manifested by severe pain at every step and accompanied by a snapping noise in the region of the trochanter which disappeared when the weight was removed. As a cause, the author found a tendinous strand. The operation consisted of fixing this strand to the trochanter which stopped the snapping and disability. Two years later the same sort of thing appeared on the other side. The strand found was somewhat thicker than on the left side, but the trouble was corrected by similar operation.—*Henry O. Feiss, Cleveland, Ohio.*

Notes on the So-called Snapping Hip. By Pupovac. *Wien. klin. Wochenschr.*, 1908, Nr. 19.

A 26-year-old patient after a trauma of a certain kind presented a noticeable bond over the great trochanter. He limped because he would keep his hip extended in slight adduction. The author found that the normal anchorage of the ileo-tibial bond had been disturbed on account of a partial tearing off of the muscle bundles lying behind the trochanter. He operated, doing a plastic on the muscle and fascia. The result was a permanent cure. —*Henry O. Feiss, Cleveland, Ohio.*

Orthopedics as a Specialty and its Limitations. By Vulpius. *Münch. med. Wochenschr.*, 1908, 5.

The author deals with two questions: 1. May orthopedics justly be regarded as a specialty? 2. What are its limitations? In answering the first question the author takes the affirmative side because the work offers certain requirements, such as special training, special qualities, special inclinations, special apparatus, etc. He believes that in smaller universities the work may be carried on in conjunction with the surgical clinic, but in the larger institutions it must be carried on separately. With regard to the second question, he believes with Hoffa in limiting the specialty to such congenital and acquired deformities of the body as manifest themselves in deformation in attitude and shape of the skeletal system.—*Henry O. Feiss, Cleveland, O.*

The Relaxed Knee-joint. By Albert H. Freiberg, M. D., Cincinnati, O. *Am. Jour. Med. Sciences*, May, 1908.

Freiberg describes a knee-joint affection "characterized by the occurrance of attacks of very sharp pain, immediately followed by complete loss of strength in the joint, so that the patient often falls; upon moving the joint a few times the pain commonly disappears, but is followed by the development of an effusion into the joint. After a few days of joint soreness and sense of insecurity the effusion vanishes and an interval of comparatively normal function ensues."

The first attack is almost invariably preceded by some trauma of the joint, though oftentimes slight but subsequent attacks may occur upon slight provocation, such as turning while standing erect or going up or down stairs.

These cases have often been diagnosed as injured or displaced meniscus,

but lack the characteristics of the latter in not having the sharply localized tenderness over the cartilage and in completely recovering between attacks. In some cases, especially those with frequent recurrances, the grating on motion of the joint, indicative of villous hypertrophy, is found but in many it is absent.

Between attacks the joint may be so nearly normal as to lead one who is not familiar with the condition to believe it is so, but a careful comparison of the two thighs reveals an atrophy of the quadriceps extensor muscle on the affected side of from one-half to one inch. Freiberg believes this atrophy to be the result of the initial trauma and that it results in a relaxation of the capsule when the knee is extended thus allowing it to become pinched between the femoral condyle and the tibia. There is no "locking" of the joint at the time of attack so characteristic of displaced semilunar cartilage,

The treatment recommended consists of massage, vibratory or manual. hot and cold douches, active exercise with resistance, faradic electricity and such other measures as will improve the circulation and increase the volume of strength of the atrophied quadriceps. This may take from six weeks to six months but has always in the author's experience resulted in a cure.—*John L. Porter.*